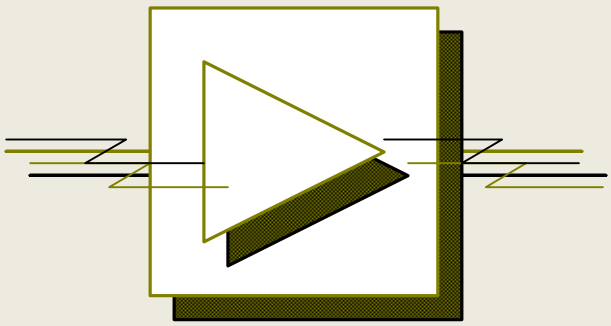
Instruction Manual

Tower Mounted Amplifier



See last page for document revision information

Tower Mounted Amplifier Instruction Manual

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Please report errors and provide suggestions

TMA-1 Tower Mounted Amplifier Instruction Manual

I. General Description

A. Introduction

The tower mounted amplifier described here was originally designed for use with e-CALLISTO. It includes two assemblies, the tower mounted amplifier assembly (TMA) and LNA power coupler assembly (LPC). The TMA and LPC are built, tested and sold as a pair and are collectively referred to as TMA. In addition to this Instruction Manual, a set of mechanical and electrical drawings is provided on CD (filename TMA-LPC_Elec-Mech.pdf).

The TMA is equipped with one or two low noise amplifier modules, “A” circuit or “A” and “B” circuits, depending on the configuration. The “B” circuit is optional. The LPC is equipped with cabling to accommodate both TMA configurations. The LPC supplies power to both amplifier modules, “A” and “B”, through the “A” circuit. Refer to the block diagram (figure 1). Also, refer to the system drawings included with the TMA/LPC combination.

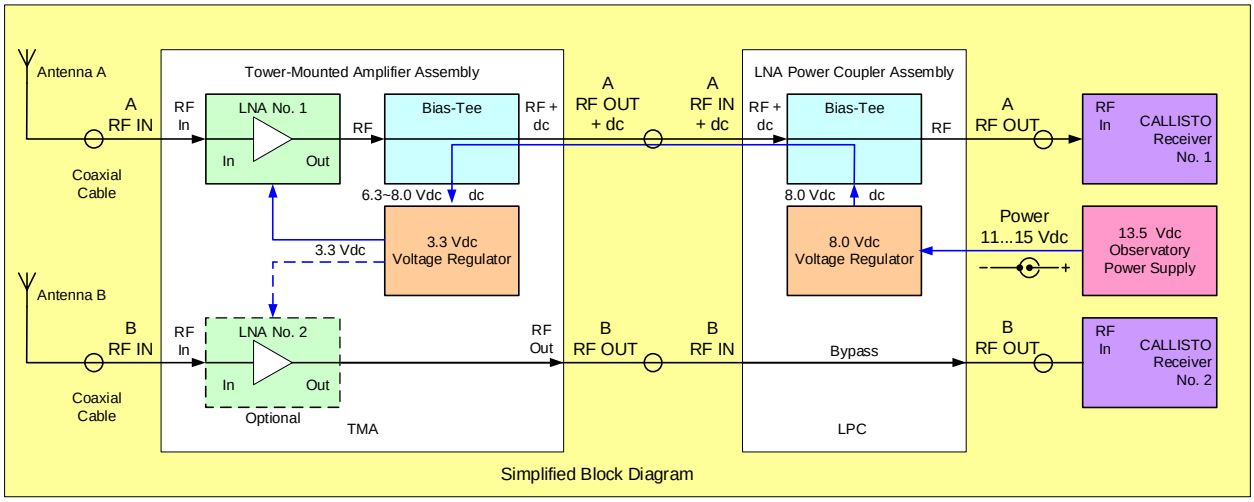


Figure 1 ~ System block diagram showing interconnections.

If this equipment is to be used for calibrated measurements (such as calibrated measurements of solar flux or any other weak signals) the temperature stability of the TMA (and the associated receiver) should be taken into account. The gain and noise of the TMA (and receiver) vary slightly with ambient temperature. Refer to the specifications and datasheets for the individual components. Datasheets for the modular components are available from the manufacturer, Mini-Circuits, at http://www.minicircuits.com/.For high measurement stability, the TMA (and receiver) should be placed in a temperature-controlled environment.

B. Basic Specifications

Parameter	Value	Remarks
Frequency range	nominal 10 ~ 1000 MHz	Test limits
Transmission gain	nominal 21 ~ 17 dB	Measured at test limits, varies with frequency, Circuit “A” gain slightly less than Circuit “B” at higher frequencies
RF connectors	N-female	
Input voltage	nominal 12 Vdc, range 11 ... 15 Vdc	Power jack wired CENTER POSITIVE
Input current	nominal 130 mA	Each LNA module uses approximately 82 mA maximum
Dimensions	TMA: 9.5 in L x 7.4 in W x 5.3 in D (241 mm L x 188 mm W x 135 mm D) LPC: 7 in. L x 5 in W x 2 in H (178 mm L x 127 in W x 51 mm H)	
Weight	TMA: 3.75 lb (1.7 kg) LPC: 1.25 lb (0.6 kg)	TMA weight varies slightly with options

II. Installation

A. Transmission Considerations and Pre-Installation Tests

Caution: The TMA may be shipped partially assembled and may require final assembly before testing and installation. See Appendix A.

It is suggested that all components used in the installation be tested together before installation to verify proper operation according to local practices. This includes the TMA and LPC assemblies as well as the user-provided coaxial cables, power supply and receivers.

Detailed transmission design and pre-installation tests are beyond the scope of this document, but the following information is provided to assist the user with integration of the tower mounted amplifier. The major active and passive components used in the signal chain are shown in table 1 along with their loss or gain according to the manufacturer's (Mini-Circuits) datasheets. These should be treated as typical values and are subject to manufacturing tolerances and temperature effects.

Table 1 – Manufacturer's datasheet gains and losses. Linear interpolation may be used for unspecified frequencies within the range given. The values do not include cable losses.

	ZX60-33LN+ low noise amplifier	ZFBT-4R2G bias-tee	VLM-33+ voltage limiter
Frequency (MHz)	Gain (dB)	Loss (dB)	Loss (dB)
10		0.16	
30			0.06
50	21.75		0.04
70			0.04
90			0.04
100	21.65		
114.75		0.22	
190			0.06
200	21.54		
300	21.34		
324.25		0.53	
400	21.06		
415			0.10
500	20.71		
600	20.28		
700	19.61		
743.25		0.29	
800	19.37		
820			0.21
900	19.11		
952.75		0.32	
1000	18.80		
1200			0.19

In addition to the major components there are other components or conditions that introduce circuit losses including mismatch losses and coaxial cables losses. Where coaxial connectors of the type used in the TMA are properly installed they do not introduce appreciable transmission losses below 900 MHz. Mismatch losses are not discussed here. Typical measured insertion losses for the TMA and LPC assemblies are shown in figure 2. The test circuits are shown in the appendix.

At lower frequencies, the LNA gain is nominally the same as indicated in the amplifier datasheet. At higher frequencies there are implementation losses due to cables and, for "Circuit A", the two bias-tees. When longer interconnecting cables are used, the gain will be less than shown in the plot and will roll off more.

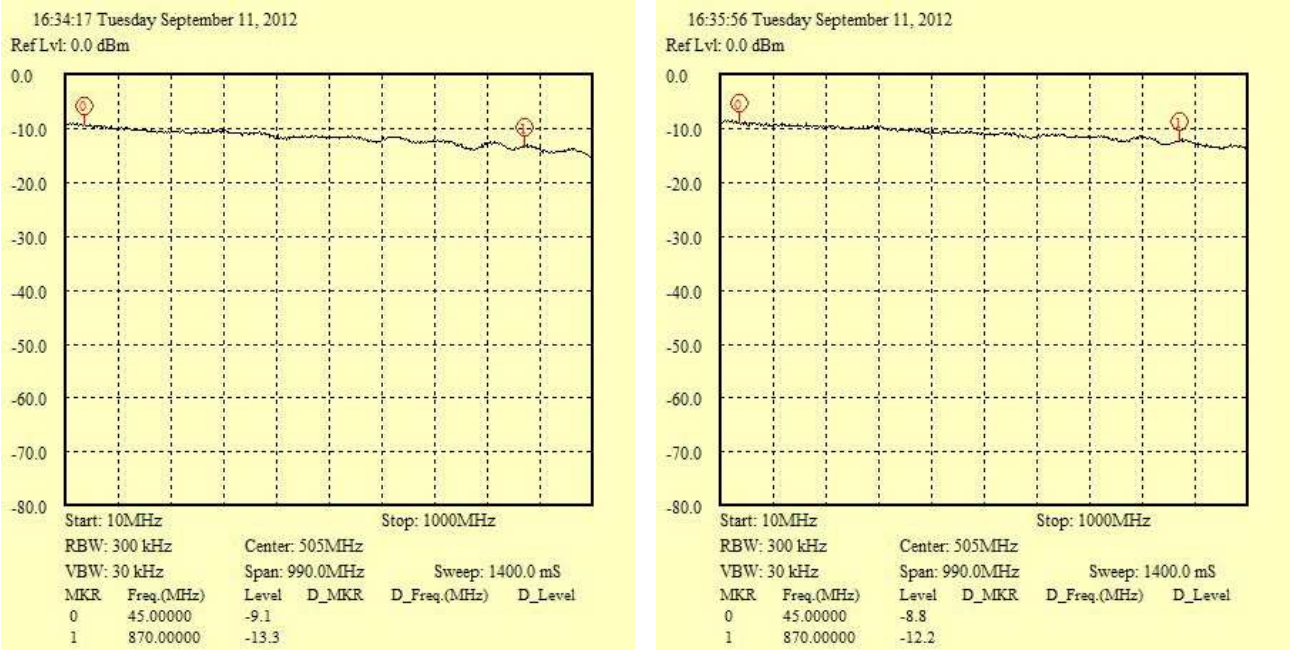


Figure 2 ~ Typical transmission loss for circuit "A" (left) and circuit "B" (right). Add 30 dB to displayed levels (tracking generator level is –30 dBm). See note.

Note to figure 2: Transmission losses shown above are typical and include the internal cables. Expect variations due to component tolerances. Measurements were made using a tracking generator/spectrum analyzer under the following conditions after 30 minute warm-up period at room temperature:

- Coaxial cable between tracking generator RF Output and TMA RF Input: RG-142, 100 cm long
- Coaxial cable between LPC RF Input/dc and TMA RF Output/dc: RG-142, 50 cm long
- Coaxial cable between LPC RF Output and spectrum analyzer RF Input: RG-142, 50 cm long
- When characteristics of one circuit are measured, both input and output of the other circuit are terminated with 50 ohm terminations
- Tracking generator level –30 dBm (add 30 dB to displayed values)
- Markers: 45 and 870 MHz

B. Tower Mounted Amplifier Installation

Caution: The TMA may be partially disassembled for shipment. If so, a paper warning flag will be inserted in the TMA cover. In this case, the TMA will require final assembly before testing and installation. See Appendix A.

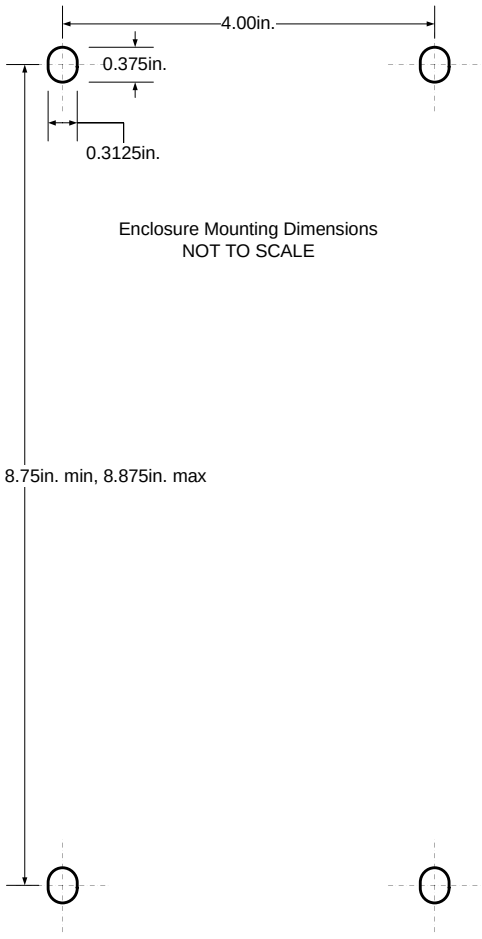
Caution: To minimize transient voltages on active components in the TMA and LPC assemblies and to prevent accidental opening of the power fuse in the LPC, DO NOT apply power to the LPC until all transmission line connections have been made between the TMA and LPC.

Caution: The TMA is not equipped with reverse polarity protection; only the LPC s/n LPC005 and later is equipped with reverse polarity protection. Do not connect anything to the circuit A: RF output + dc port unless its polarity and voltage are known to be correct. The TMA maximum input voltage is 8.0 Vdc.

Caution: Never connect a feedline with powering voltage on its center conductor to the Circuit B: RF output port. If you connect a feedline with powering voltage to Circuit B: RF output port, you will destroy the LNA module associated with Circuit B.

The TMA assembly should be located as close as possible to the antenna system. The TMA has mounting brackets that may be fastened to channel struts or other supports. Mounting dimensions are shown in figure 3. Fasteners and mounting hardware exposed to the weather must be suitable for the environment, generally galvanized steel or stainless steel. The TMA has provisions for bonding the metallic components and internal lightning arrestors to an earth electrode system.

When mounting the TMA orient it with the RF connectors and weep-hole at the bottom. All RF connectors on the outside of the enclosure are female N-type connectors, and the corresponding coaxial cables must have male N-type connectors. Connectors should be made up finger-tight. Never use a wrench or pliers on the N-type connectors. After all connections have been made, seal them with rubber mastic tape or coaxial connector sealing products made for that purpose. If a TMA with two LNA modules is installed but RF connections are made to circuit "A" only, all circuit "B" connections at the TMA should be terminated with 50 ohm terminations and these terminations should be sealed as with the active circuit. If equipped, the circuit "B" LNA is powered even though it may not be used.



For a TMA with one LNA module, connections are made only to circuit "A", the powering circuit. For a TMA with two LNA modules, connections are made to both circuit "A" and circuit "B". It is suggested that before the coaxial cables are installed they be marked with colored tape or heat-shrink tubing. This will help reduce the possibility of incorrect connections to the circuits during and after installation. On the system drawings, circuit "A" is color coded red and circuit "B" is color coded green.

Figure 3 ~ Tower Mounted Amplifier mounting dimensions in inches

C. LNA Power Coupler Installation

Caution: To minimize transient voltages on active components in the TMA and LPC assemblies and to prevent accidental opening of the power fuse in the LPC, DO NOT apply power to the LPC until all transmission line connections have been made between the TMA and LPC.

Caution: LPC serial numbers LPC004 and lower are not equipped with reverse polarity input protection. Do not connect anything to the dc power input unless its polarity and voltage are known to be correct. LPC serial numbers LPC005 and later are equipped with reverse polarity input protection.

The LPC assembly should be located at a convenient indoor location close to its power source to minimize voltage drop. The minimum input voltage to the LPC is 11.0 Vdc. The LPC does not have mounting brackets, and it should not be installed where exposed to the weather or direct sunlight. It is not necessary to install the LPC near the receiver but care should be taken to minimize transmission losses. As with the TMA, all RF connections are through N-type connectors. Connectors should be finger-tight. Do not use a wrench or pliers on the N-type connectors.

The dc power connection is through a 2.1 x 5.5 mm coaxial power jack and plug. A matching locking-type plug is supplied with the TMA/LPC. The user must solder insulated conductors to the power plug and provide power supply connections. The power plug can accommodated 18 AWG (1 mm diameter) or smaller insulated stranded conductors.

IMPORTANT: The power plug must be wired with center positive. **Double-check the polarity before inserting the plug; see caution above.** The allowable input voltage range is 11 to 15 Vdc. The dc power source should be well filtered and capable of supplying at least 300 mA. The LPC has provisions for bonding the metallic components to an earth electrode system.

For an LPC used with a TMA having one LNA module, RF transmission line connections are made only to circuit "A", the powering circuit. For an LPC used with a TMA having two LNA modules, RF transmission line connections are made to both circuit "A" and circuit "B". It is suggested that before the coaxial cables are installed that they be marked with colored tape or heat-shrink tubing. This will help reduce the possibility of incorrect connections to the circuits during and after installation.

D. Post-Installation Tests

It is recommended that a set of transmission and noise measurements be made immediately after installation. These measurements will provide a baseline for comparison with maintenance measurements made later.

III. Operation and Use

A. Tower Mounted Amplifier

The TMA has no operating controls. Power for the TMA is supplied by the LPC through the “Circuit A” coaxial cable. When power is applied to the TMA through the LNA Power Coupler, the green LED on the TMA power supply will illuminate. This LED is not visible when the cover is on the TMA but can be used for circuit verification and troubleshooting after installation.

B. LNA Power Coupler

The LPC requires a dc power source with an output voltage between 11 and 15 Vdc. The LPC is equipped with a cartridge fuse, type 2AG (5 mm x 15 mm), 375 mA, time delay (time lag or “Slo Blo”). The LPC is supplied with one installed fuse and one spare fuse. If additional fuses are required, replace with Cooper-Bussmann p/n C519-375mA or Littelfuse p/n 229.375 or equivalent.

The LPC has an On/Off switch located on one end panel just above the coaxial dc power jack. The switch controls power to the LPC internal power supply and, in turn, the TMA power supply. To operate the TMA/LPC after all RF and power cable connections have been made as described in the Installation section, move the power switch to the On position. A green light emitting diode (LED), located immediately above the On/Off switch, illuminates when power is turned on. If the LED fails to illuminate, check the power supply, power cable and connector and fuse.

IV. Circuit Description

A. Introduction

Both the TMA and LPC have provisions for an optional second low noise amplifier and can be used with any receiver within the TMA's operating frequency range. The TMA/LPC combination has been tested from10 MHz to 1 GHz but the amplifier is rated to 3 GHz. The following description applies to a TMA with one LNA module

B. Tower-Mounted Amplifier Assembly

The tower mounted amplifier is based on the Mini-Circuits ZX60-33LN+ low noise amplifier (LNA) module and Mini-Circuits ZFBT-4R2G+ bias-tee power coupler modules. The low noise amplifier module provides a nominal 20 dB gain (typically 21.8 dB at 50 MHz and 19.1 dB at 900 MHz). The datasheet frequency range of the ZX60-33LN+ amplifier is from 50 to 3 000 MHz, but tests show that its lower frequency extends to at least 10 MHz. In e-CALLISTO applications, the operating range is 45 to 870 MHz. The amplifier datasheet shows a nominal 1.0 dB noise figure across the e-CALLISTO frequency range. However, implementation losses slightly increase the noise figure.

The Tower-Mounted Amplifier components are enclosed in a weatherproof polyester enclosure as shown in figure 4. A schematic is provided in figure 5. A lightning arrestor assembly with a type-N coaxial connector provides a means of coupling the antenna to the low noise amplifier module. The RF input port of the amplifier module is connected directly to the arrestor and its output is connected to the bias-tee power coupler through a Mini-Circuits VLM-33+ voltage limiter. The limiter prevents momentary surge voltages on the bias-tee RF port from damaging the amplifier. The other side of the bias-tee connects directly to a type-N coaxial connector, which carries amplified RF back to the LPC and dc from the LPC to the TMA. The dc output from the bias-tee in the TMA is connected to a linear regulated power supply, which supplies 3.3 Vdc to the amplifier module. The voltage input to the linear regulator must be within the range of 6.3 to 8.0 Vdc.

Figure 4 ~ Typical tower mounted amplifier assembly equipped with one low noise amplifier module. Variations exist depending on ordering requirements and options specified.

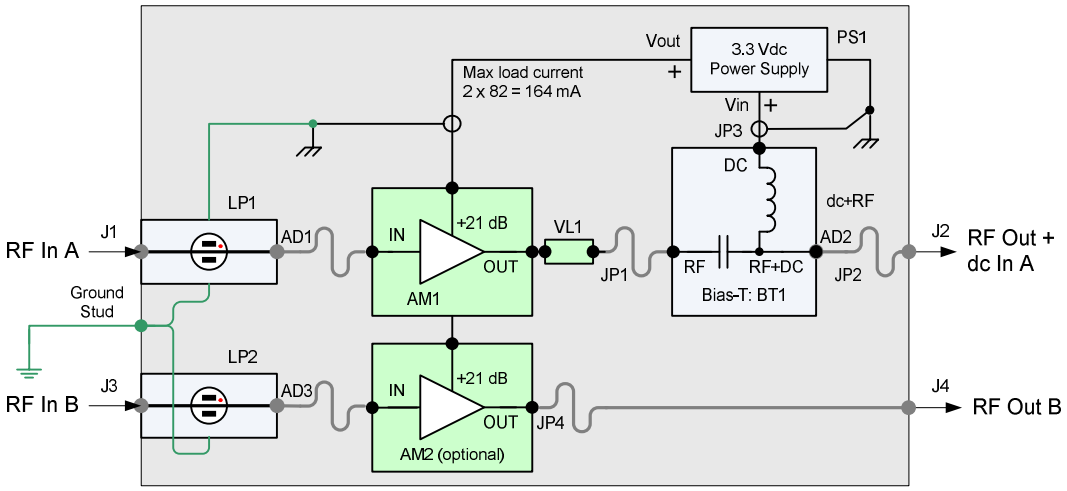


Figure 5 ~ Tower mounted amplifier schematic

TMA Features:

- Weatherproof polyester enclosure;
- Powering through RF coaxial cable;
- Provisions for bonding and grounding using stainless-steel fasteners;
- The enclosure includes a small hole on the bottom to prevent pressure build-up due to temperature changes and for moisture drainage. The hole is screened against insect intrusion;
- In TMAs provided with one low noise amplifier module, pilot holes have been drilled (and plugged) for a second lightning arrestor and unpowered transmission line feed to a second receiver. The holes may be enlarged with a common hole saw. An upgrade kit is available;
- All internal RF connections are through type-SMA connectors and RG-316/U coaxial cable and all power connections are through RG-174/U coaxial cable;
- Internal power supply consists of only four electronic components, three filter capacitors and a fixed voltage regulator integrated circuit;
- The aluminum chassis is painted with self-etching primer;
- The enclosure dimensions are nominally 8 in high x 6 in wide x 4 in deep (approximately 200 mm x 150 mm x 100 mm) not including the cover.

C. LNA Power Coupler Assembly

The LNA Power Coupler has provisions for powering and connecting two low noise amplifiers in the TMA and is shown in figure 6. A schematic is provided in figure 7. One transmission line carries amplified RF from the low noise amplifier in the TMA back to a receiver. This transmission line also carries direct current for powering up to two low noise amplifiers in the TMA. Another transmission line carries RF from an optional second low noise amplifier in the TMA back to a second receiver. This bypass transmission line is unpowered. External power within the range of 11 to 15 Vdc is supplied to the LPC where it is converted to 8.0 Vdc by a linear regulated power supply. A bias-tee in the LPC couples power to the coaxial transmission line to the TMA. At the TMA, the power is decoupled from the transmission line by another bias-tee and connected to an internal power supply for the amplifier modules.

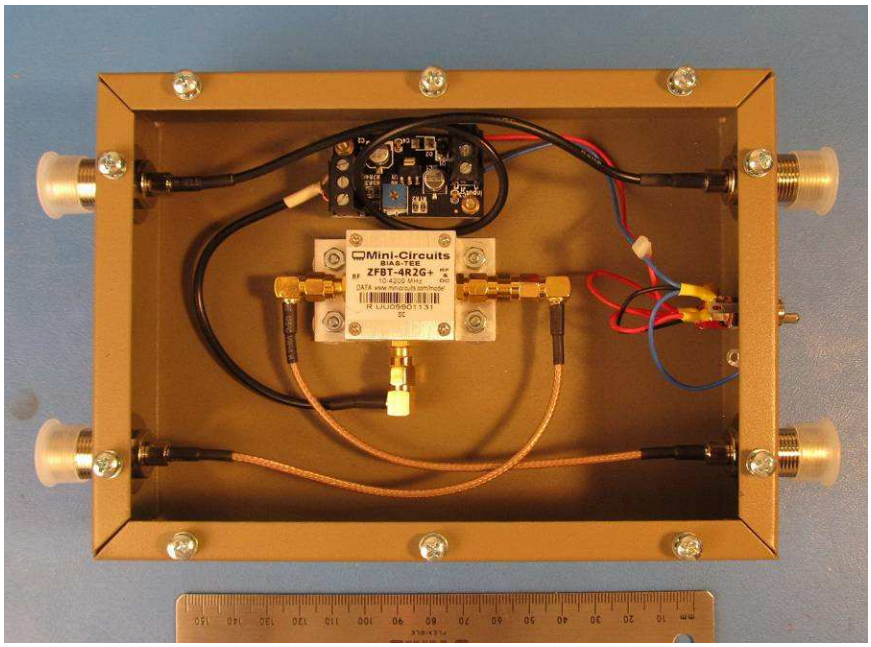


Figure 6 ~ LNA Power Coupler assembly. The bias-tee is near the center and the linear regulator power supply is just above it. The lower N-type connectors on the left and right are circuit "A" and the upper connectors are circuit "B". Variations exist depending on ordering requirements.

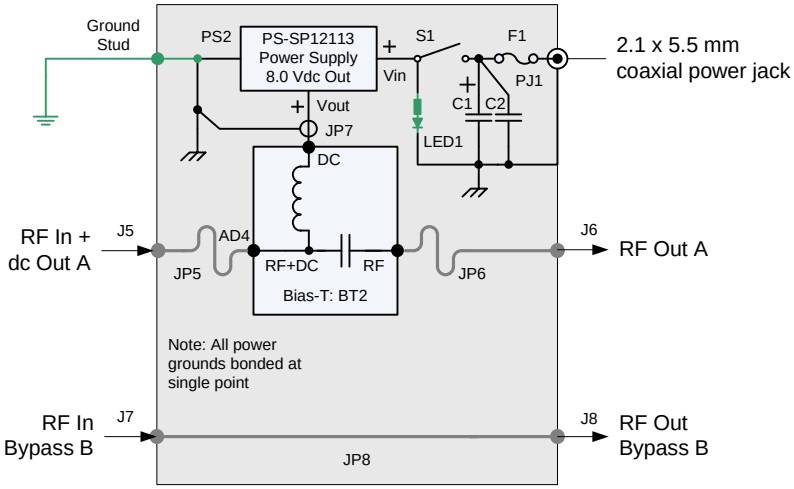


Figure 7 ~ LNA Power Coupler schematic

LPC Features:

- Input voltage of the LPC is nominal 11 to 15 Vdc. RF from the tower-mounted amplifier is coupled back to the LPC through the same connector;
- Power On/Off switch, LED power indicator, fuse and coaxial power connector (2.1 x 5.5 mm, center positive);
- Linear power supply supplies 8.0 Vdc through the bias-tee power coupler to an N-type coaxial connector;
- Reverse polarity protection (s/n LPC005 and later);
- All internal RF connections are through SMA-type connectors and RG-316/U coaxial cable and all power connections to the bias-tee are through RG-174/U coaxial cable;
- Aluminum enclosure is painted with self-etching primer and top-coated with dark taupe enamel;

- Enclosure bottom plate (not shown) is fastened with ten machine screws;
- Stainless-steel fasteners for connecting an earth bonding conductor;
- Enclosure is 7 in long x 5 in wide x 2 in high (approximately 178 mm x 127 mm x 50 mm).

V. Maintenance

A. Purpose

This section describes preventative maintenance that is performed to ensure the reliability of the tower mounted amplifier and LNA power coupler assemblies . The tasks are simple and routine and will keep your equipment in top condition.

Observe anti-static practices at all times

B. Annual Preventative Maintenance

- ☼ Brush dust off the instrument being careful to not disturb the connections
- ☼ If additional cleaning of the enclosure and panels is required, use a damp cloth; DO NOT use any chemicals
- ☼ Check for loose connectors and frayed insulation on cables
- ☼ Check power supply voltage, 11 to 15 Vdc
- ☼ If a wideband noise source is available check the noise performance. The procedures below apply to the combination of TMA/LPC and CALLISTO Receiver. A noise source with about 15 dB excess noise ratio (ENR) is required. Apply the noise source to the TMA RF Input.

  Derive the noise figure of the instrument combination as follows (set CALLISTO Receiver gain to PWM = 150):

  1) Measure V_{cold} by applying a 50 ohm resistor to the antenna input and take a spectral overview (see CALLISTO Software Setup Guide);
  2) Measure V_{hot} by applying the noise source to the antenna input and take a second spectral overview;
  3) Calculate the Y-factor in dB: $Y(dB) = (V_{hot} - V_{cold})/25.4$ mV/dB;
  4) Convert Y-factor to linear ratio: $Y = 10^{[Y(dB)/10]}$
  4) Derive the noise figure, NF, of the instrument from NF(dB) = ENR(dB) – 10*log(Y-1), where ENR is the excess noise ratio of the noise source adjusted for cable losses. NF of the CALLISTO Receiver should be less than 10 dB and the NF of the combination TMA/LPC and receiver should be less than about 3 dB.

C. Additional Maintenance Tasks ~ Perform Only As Necessary

1. Remove internal chassis from TMA Assembly

Observe anti-static practices at all times

Tools: 5/16 in or 8 mm open-end wrench, Phillips No. 2 screw-driver

a. Note that the connectors and LNA modules are marked red and green with fingernail polish
b. Remove the LNA power cable connector from the power supply module.
c. Remove the SMA-M connectors from each LNA Out port
d. Hold the LNA module to keep it from turning and then unscrew the SMA-M connector on the LNA In port. The SMA-M connector is part of the N-M adapter connected to the lightning arrestor
e. Handle the two LNA modules very carefully and set them aside; do not strain the soldered power cable connections on the LNA modules
f. You may remove the two SMA-M/N-M adapters from the lightning arrestors. They are finger-tight and no tools are required

g. Remove the grounding hardware by removing the 10-32 wing nut and small flat washers, 10-32 standard hex nut, split lock washer and large flat washer from the outside of the enclosure. Pull the 10-32 screw out from the inside. This will free the bonding leads connected to the lightning arrestors and chassis
h. Remove the four screws from the chassis, one in each corner
i. Carefully lift the chassis up and out from the enclosure enough to remove the bonding lead. Remove the bonding lead hardware and completely remove the chassis from the enclosure

2. Re-Install internal chassis in TMA Assembly

Re-installation of the chassis is a reverse of the removal procedures. At all times observe anti-static practices:

Tools: 5/16 in or 8 mm open-end wrench, 5/16 in torque wrench, torque Phillips No. 2 screw-driver

a. Observe the color code used on all connectors and modules
b. Place the chassis in the enclosure enough to replace the bonding lead and associated hardware then position the chassis in the enclosure so the four mounting holes line up with the embedded fasteners in the enclosure
c. Replace the four screws, one in corner of the chassis; tighten to 4~6 in-lb (0.45~0.68 N-m) torque
d. If the SMA-M/N-M adapters were removed from the lightning arrestors, replace them. DO NOT use any tools to tighten the N-connectors; tighten them finger-tight (over-tightening these connectors may cause the lightning arrestor to rotate and break their seal
e. Reconnect the In port on the LNA modules to the SMA-M/N-M adapter; hold the LNA modules while tightening the connectors so they cannot rotate; tighten to 3~5 in-lb (0.34~0.57 N-m) torque
f. Reconnect the SMA-M connectors to the LNA Out port; hold the LNA modules while tightening the connectors so they cannot rotate; tighten to 3~5 in-lb (0.34~0.57 N-m) torque
g. Reconnect the LNA power cable connector to the power supply module
h. Examine the power connections to ensure there are no broken wires
i. Reinstall the grounding hardware with the bonding leads immediately below the 10-32 screw head followed by a large flat washer. Push the 10-32 screw through the enclosure hole and place a large flat washer on the outside followed by a split lock washer and hex nut. Tighten the fasteners to 20~27 in-lb (2.3~3.4 N-m) torque. Replace the small flat washers and wing nut

3. Remove bottom plate from LPC Assembly

Observe anti-static practices at all times

Tools: Phillips No. 2 screw-driver

a. Remove the ten 6-32 fasteners (machine screws with internal tooth lock washers) holding the bottom plate to the LPC chassis
b. Remove plate and set aside

4. Re-Install bottom plate on LPC Assembly

Re-installation of the chassis is a reverse of the removal procedures. Observe anti-static practices at all times:

Tools: Phillips No. 2 screw-driver

a. Place plate on LPC chassis and check alignment of the ten holes; it may be necessary to flip the plate around. The plate is painted on one side only and the painted side should be exposed when properly placed on the chassis
b. With your fingers, install each of the ten 6-32 fasteners and internal tooth lock washers; do not start the screws with a screwdriver or any other tool or you may damage the threads in the soft aluminum
c. After all screws are hand-threaded finger-tight, tighten each fastener with a screwdriver until it is snug; DO NOT use a motorized screw driver and DO NOT over-tighten or you will strip the threads

5. Power supplies in LPC and TMA Assemblies

a. LPC: The power supply in the LPC is not adjustable and has a fixed output of 8.0 Vdc at the Vout terminals. The power supply in LPC s/n LPC005 and later use a fixed regulator and are not adjustable. Earlier models normally will not need adjustment in the field unless the power supply has been replaced. If the power supply has been replaced, apply 13.8 Vdc to the dc power input jack on the LPC and adjust the variable resistor on the power supply so that the voltage at the Vout terminals on the power supply is 8.0 Vdc with no load.

b. TMA: The power supply in the TMA is not adjustable and has a fixed output voltage of 3.3 Vdc. The input voltage to the TMA will depend on the coaxial cable length between the LPC and TMA but should never be below 6.3 Vdc when under load.

Document History

Author: Whitham D. Reeve, Anchorage, Alaska USA

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Iss. 1.1 (Minor edits for clarification, 18 March 2013)
Iss. 1.2 (Added caution to TMA, 24 May 2013)
Iss. 1.3 (Fixed error in Figure 1, added test circuit, 28 May 2013)
Iss. 1.4 (Editorial revisions, 27 May 2015)
Iss. 1.5 (minor updates to LPC, 18 Feb 2016)

IMPORTANT

DO NOT SKIP THESE STEPS

THE TOWER MOUNTED AMPLIFIER MAY BE PARTIALLY DISASSEMBLED FOR SHIPMENT TO PROTECT AGAINST BREAKAGE AND MUST BE ASSEMBLED BEFORE USE. DO NOT CONNECT OR ATTEMPT TO USE THE TOWER MOUNTED AMPLIFIER (TMA) OR LNA POWER COUPLER (LPC) BEFORE COMPLETING THE STEPS LISTED BELOW. ALWAYS USE ANTI-STATIC PROTECTION WHEN WORKING ON THE TMA.

1. LOCATE THE DOCUMENTS FOLDER ON THE CD. OPEN AND PRINT THE DRAWING FILE TMA-LPC_Elec-Mech.pdf. REFER TO THIS DRAWING WHILE FOLLOWING THE STEPS BELOW.

2. LOOSEN THE FOUR CAPTIVE SCREWS, ONE IN EACH CORNER OF THE TMA ENCLOSURE COVER AND REMOVE THE COVER.

3. LOCATE THE BUNDLE OF BUBBLE WRAP IN THE ENCLOSURE. THE BUNDLE HOLDS ONE OR TWO LOW NOISE AMPLIFIER MODULES DEPENDING ON THE TMA CONFIGURATION. THE MODULES ARE CONNECTED BY CABLES TO OTHER COMPONENTS. DO NOT PULL ON THE CABLES.

4. CAREFULLY EXAMINE THE BUNDLE AND CABLES COMING OUT OF IT. THERE IS A SIGNAL CABLE AND A POWER CABLE FOR EACH AMPLIFIER. THE SIGNAL CABLES CONNECT THE LNA MODULES TO ASSOCIATED COMPONENTS. THE POWER CABLES CONNECT THE LNA MODULES TO A CONNECTOR THAT WILL PLUGGED INTO THE POWER SUPPLY IN A LATER STEP.

5. CAREFULLY CUT THE RUBBER BAND OR WRAP-TIE ON THE BUBBLE WRAP AND CAREFULLY REMOVE THE BUBBLE WRAP FROM THE MODULE OR MODULES. DO NOT PLACE ANY TENSION ON THE CONNECTING CABLES AND DO NOT TWIST, SHARPLY BEND OR KINK THE CABLES.

6. IF YOUR TMA IS CONFIGURED WITH ONE LOW NOISE AMPLIFIER, SKIP TO THE NEXT STEP. OTHERWISE, LOCATE THE LNA MODULE WITH THE “B” CIRCUIT TAG AND CAREFULLY CONNECT IT TO THE RF ADAPTER ON THE “B” LIGHTNING ARRESTOR. HOLD THE LNA MODULE SO THAT IT CANNOT ROTATE WHILE CAREFULLY TIGHTENING THE SMA RF CONNECTOR. FIRST MAKE UP THE CONNECTOR FINGER-TIGHT AND THEN TIGHTEN WITH A 5/16 in TORQUE WRENCH TO 3~5 in-lb (0.34~0.57 N-m). DO NOT OVERTIGHTEN THE SMA CONNECTORS!

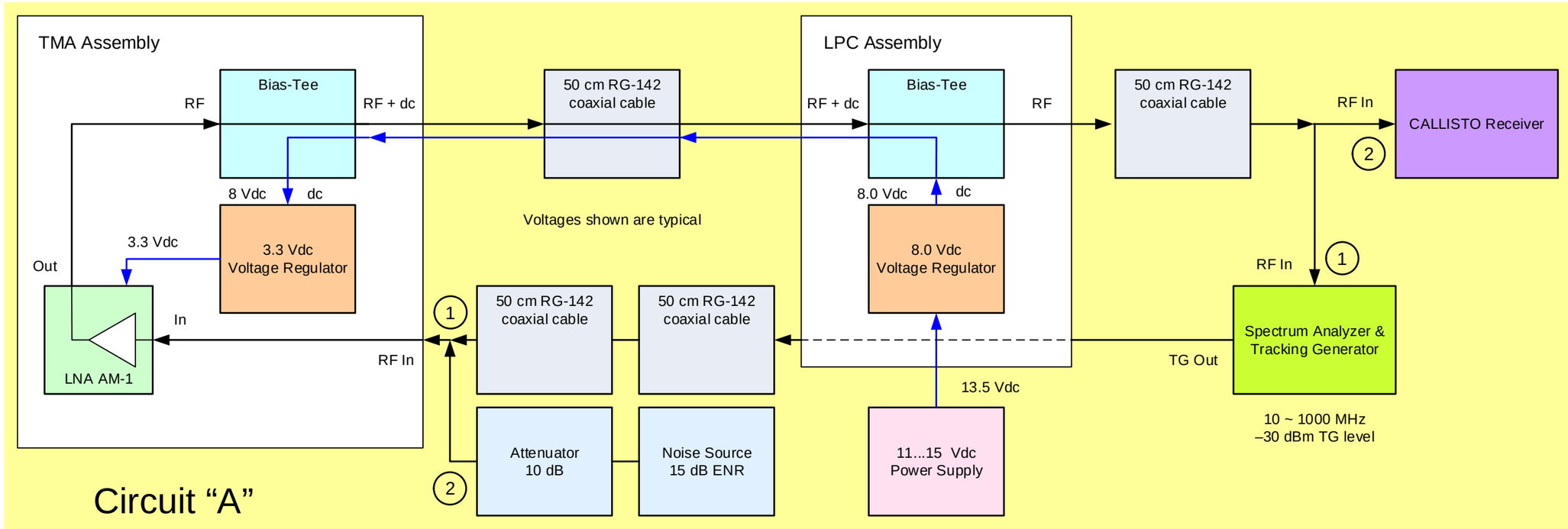
7. LOCATE THE LNA MODULE WITH THE “A” CIRCUIT TAG AND CAREFULLY CONNECT IT TO THE RF ADAPTER ON THE “A” LIGHTNING ARRESTOR. HOLD THE LNA MODULE SO THAT IT CANNOT ROTATE WHILE CAREFULLY TIGHTENING THE CONNECTOR. FIRST MAKE IT FINGER-TIGHT AND THEN TIGHTEN WITH A 5/16 in TORQUE WRENCH TO 3~5 in-lb (0.34~0.57 N-m). DO NOT OVERTIGHTEN THE SMA CONNECTORS!

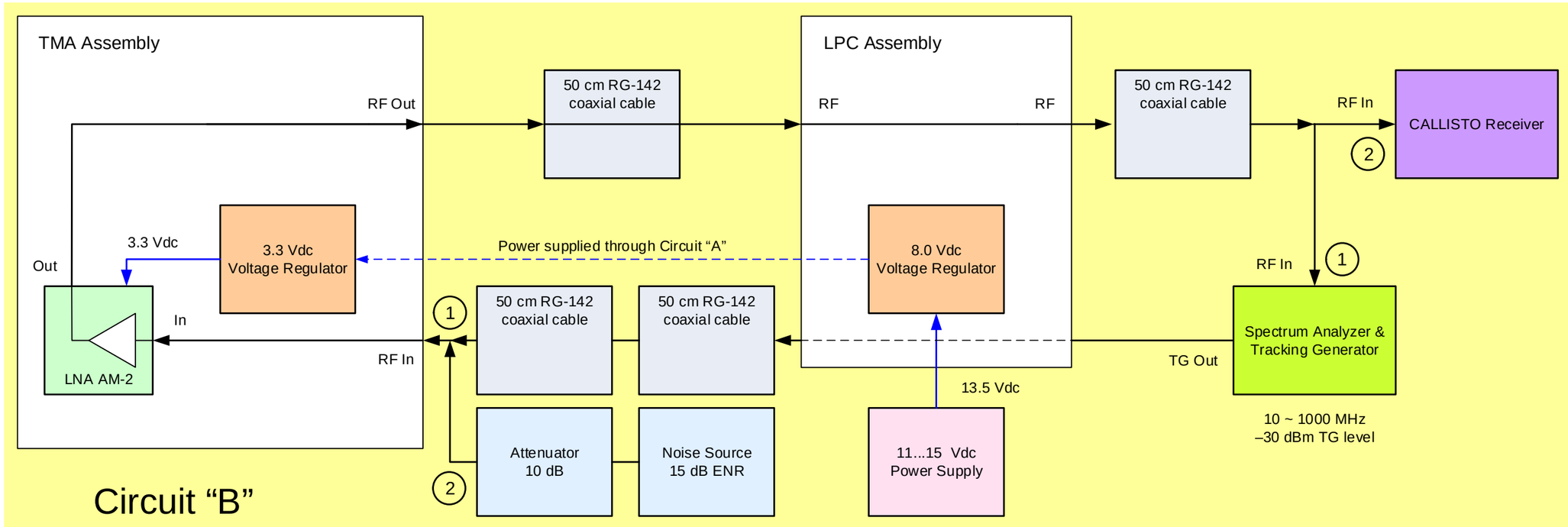
8. PLUG THE POWER CABLE INTO THE POWER SUPPLY Vout CONNECTOR. THE Vout CONNECTOR IS CLOSEST TO THE MIDDLE OF THE METAL CHASSIS PLATE. DO NOT FORCE THE CONNECTOR; IT FITS EASILY IN ONLY ONE ORIENTATION. REFER TO THE DRAWINGS IF NECESSARY.

9. CHECK ALL CONNECTIONS IN THE ENLCOSURE FOR SECURITY.

10. CHECK THE RUBBER GASKET IN THE ENCLOSURE COVER FOR PROPER PLACEMENT AND SECURITY. REPLACE THE COVER ON THE ENCLOSURE. TIGHTEN THE FOUR SCREWS IN AN ALTERNATING PATTERN SO THEY ALL ARE SNUG. DO NOT OVER-TIGHTEN.

11. THE TMA IS READY FOR INSTALLATION. REFER TO THE INSTALLATION INSTRUCTIONS.





DRAWN BY WHITHAM D. REEVE
REVISED 5/28/2013
DESCRIPTION TMA-LPC Test Setup
FILENAME LOW NOISE AMPLIFIER CALLISTO.VSD