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## **TECHNICAL MANUAL**

for

### **VHF/UHF Antenna Preamplifier**

*Model PAL-16*

**The Technical Materiel Corporation**

**Mamaroneck, New York 10543-2300**



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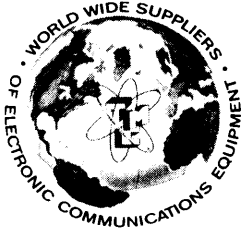
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*Model PAL-16*

**THE TECHNICAL MATERIEL CORPORATION**  
COMMUNICATIONS ENGINEERS



## **Please Read This Notice**

Dear **Valued Customer:**

Thank you for purchasing the TMC Model PAL-16 VHF/UHF Antenna Preamplifier. This model is one of a series of solidstate RF devices that provide linear amplification of low-level RF signals from a receiving antenna through to a communications receiver. The PAL-16 provides a nominal gain from antenna to receiver of 25dB. The preamplifier is described in detail in the enclosed technical manual. Product bulletins and application notes, as appropriate to the PAL-16, are also included. These publications provide important information about using TMC equipment. Please read them.

If you need additional data or some specific technical information, please give our Customer Service a call at **(914) 698-4800** or return the business reply card provided in this package. Our FAX (facsimilie) number is **(914) 698-4805** and our INTERNET e-mail is **TECMATC@AOL.COM**.

If you are missing any items, please contact TMC directly or through your local sales office.

Thank you for selecting the TMC Model PAL-16, VHF/UHF Antenna Preamplifier.

**The Technical Materiel Corporation**  
*Product Marketing*

# Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment - except electron tubes, semi-conductor devices, fuses, lamps, batteries, and articles made of glass or other fragile or expendable materials - purchased hereunder to be free from defect in workmanship and materials under normal use and service, when used for the purposes for which the same is designed, for a period of ONE YEAR from the date of delivery FOB factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

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- The defect is not the result of damage incurred in shipment from or to the factory;
- The equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise; and
- Any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

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All inquiries should be directed to the following:

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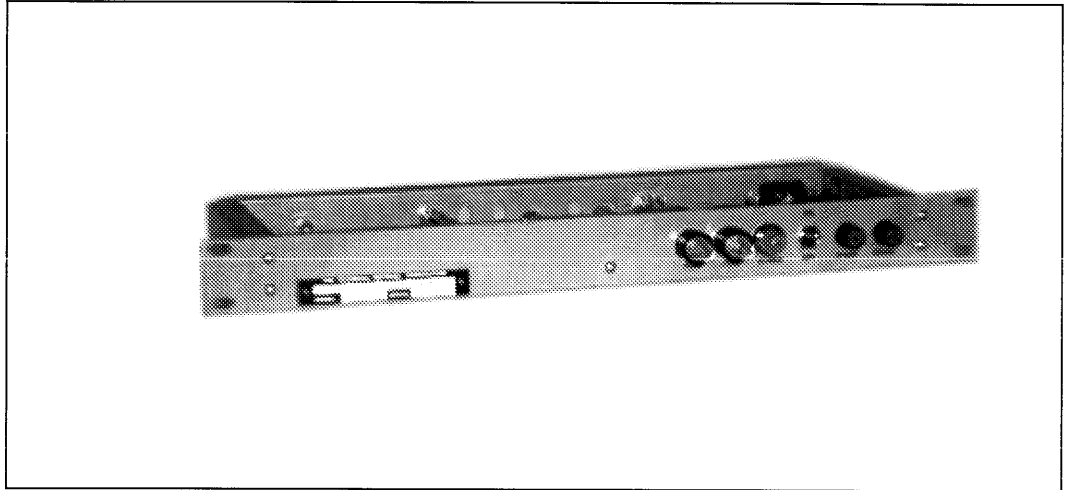
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# PAL-16 VHF/UHF Receiving Preamplifier



The designation "PAL" is used herein to refer interchangeably to the PAL-16. Any variations to this convention are noted.



# Section 1 - General Description

## 1.1 Functional Description

### 1.1.1 Overview

The PAL-16 RF Preamplifier is a rugged, conservatively-rated linear preamplifier which delivers a nominal 25dB gain throughout the 30 to 500MHz frequency range. The PAL-16 is a broadbanded unit that accepts the input from any receiving antenna and provides a 50-ohm unbalanced output to an associated communications receiver. It has a wide dynamic range and low noise characteristic over the entire frequency range. In addition, the preamplifier can be equipped with an RF overload module used to detect high-energy fields either from the antenna or the receiver. This module is particularly useful in transmitter-receiver system that utilize a common antenna. The module acts to by-pass the preamplifier circuits and prevent damage by either lightning or transmitted RF energy. A coaxial power supply is optionally available to provide in-line source voltage for operation of the preamplifier. The PAL-16 is fully solid state, including power supply components.

### 1.1.2 Major Assemblies

The PAL-16 consists of one preamplifier module with associated in-line filters, one optional RF overload control module, and an internal regulated power supply. All components are housed in a fabricated aluminum chassis, normally 19-inches wide by 1.75 inches high.

### 1.1.3 Input/Output Characteristics

The input and output characteristic impedance is 50 ohms, with a VSWR better than 1.5-to-1. A change in the characteristic impedance of the antenna will not adversely affect the operation of the preamplifier which provides a nominal 25dB gain across the frequency range.

### 1.1.4 RF Terminations

Input/output connectors, other than the BNC-type normally installed, may be substituted depending on the interconnect required at the receiving site. A wide range of terminating connectors are available including N, C and UHF.

## 1.2 Physical Description

### 1.2.1 Equipment Mounting

The PAL-16 is designed for mounting in a standard TMC aluminum chassis. There are no operating controls on the preamplifier assembly which is pre-set at the factory for optimum performance. The RF overload control module is mounted adjacent to the preamplifier assembly in the same chassis. The RF input and output connectors are mounted to the rear panel. All circuits are mounted on printed circuit boards which are in turn securely fastened to the individual modules. Grounding is provided through the modules to the chassis which in turn is provided with an external ground connection.

### 1.2.2 Semiconductor Complement

A list of replaceable semiconductors used in the PAL-16 are listed on the schematic diagram.

## 1.3 Technical Specifications

**Frequency Range** 30-500MHz.

**Input/Output Impedance** Nominal 50 ohms, unbalanced. BNC-type connectors

**Insertion Gain** Nominal +25dB over operating range.

**Frequency Response** +/-1.0dB

**Noise Figure** Less than +7dB.

**Intermodulation Distortion** For 50-ohm units: Second order is greater than -60dB for a 0.4-volt input; Third order is greater than -65dB.

**VSWR** Output is better than 1.2-to-1; Input is better than 1.5-to-1.

**Mean-Time-Between-Failure** Nominally 40,000 hours.

### Operating Features

**Cooling** Convection, no fans or moving parts

**Ambient Conditions** -20°C to +50°C; 95% R.H. Storage -40°C to +80°C

**Primary Power** 115VAC standard/230VAC optional, 47-400Hz, single phase. PSP-12 is an optional coaxial power supply that provides +15vDC operating voltage to the PAL-16.

**Power Consumption** 25W maximum.

**Size and Weight** 1.75H x 19.0W x 7.0D inches, lbs (14.1Kg)

PSP-12: 3.5H x 14W x 5.5D inches, 4lbs (1.8Kg) mounted to 3.5H x 19W panel.

### Special Features

**Monitoring** Indicating fuseholders display status of primary power circuits. An LED indicator is provided when overload RF triggers the preamplifier bypass circuits, removing the PAL-16 from the receive RF path.

**Safety** Fuse and front-end overload protection, preventing circuit failure from high RF voltages at the input. High voltage points are covered and labelled.

**Components and Construction** Totally solid state circuits mounted to an aluminum alloy chassis. External hardware is stainless steel.

## 1.4 PAL-16 Product Group

PAL-16-\* VHF/UHF Antenna Preamplifier

\* Used to identify sub-models based on input filters installed

PAL-16 Options:

- /5 50-ohm operation
- /30 300-ohm operation
- /A Internal attenuator to reduce gain
- /C C-type coaxial connectors
- /F1..5 Selected input RF filters for LP/BP/HP operation
- /N N-type coaxial connectors
- /P In-line coaxial power supply, Model PSP-12
- /T RF overload transfer control
- /U UHF-type coaxial connectors

When ordering, specify both model and option. Example: PAL-16/5F5

## Section 2 - Installation

### 2.1 Initial Inspection

#### 2.1.1 General

Every PAL-16 undergoes a thorough testing and calibration prior to shipment. Upon receipt of the unit, check the packing case and its contents for obvious damage. Unpack the equipment carefully to reduce the risk of damage and to avoid misplacing any parts shipped as loose items. See Table 2.1 for a list of the loose items.

#### 2.1.2 Damage By Carrier

With respect to equipment damage for which the carrier is liable, TMC will assist in describing methods of repair as well as furnishing replacement parts.

### 2.2 Electrical Installation

#### 2.2.1 Primary Power

The PAL-16 operates from a 115VAC, 47-400Hz single-phase power source. Optionally, it may be wired for 230VAC, which will be noted by a decal on the rear panel adjacent to the input power connector.

#### 2.2.2 External Connections

The following external connections must be made to the PAL-16 for installation:

##### Antenna Input

The antenna cable must be fitted with a connector that mates with the PAL-16 connectors provided. Normally, this is a BNC-type connector, although such connectors as type N are also available. This antenna cable is then connected to ANTENNA INPUT jack on the rear panel.

##### Output to Receiver

Connect the output of the PAL-16 to the associated receiver via the RF connector mounted on the rear panel. RF coaxial cables, terminated with the proper mating connectors - normally BNC - are required.

##### Power

Connect primary power to the amplifier at the rear panel by using the power cable provided. Ensure that the plug lines up properly with the socket using the keyway as a guide.

### 2.2.3 Clearance Requirements

The PAL-16 chassis should be located in such a way that sufficient clearance is obtained at the rear of the unit for making all RF connections. The solid state design of the PAL-16 reduces heat-related problems. The little heat developed is conducted to the environment through the slots in the top and bottom chassis covers.

## 2.3 Performance Check

### 2.3.1 General

When the appropriate power connections have been made to the PAL-16, turn the POWER switch to the ON position. The POWER lamp will light, indicating that the PAL-16 is ready for use. No further checks are required.

**Table 2.1 - Loose Items Supplied**

CA10505	Power Cable Assembly	1 each
212207A	Technical Manual	1 each
UGxx	Mating Connectors	Optional extra

## Section 3 - Operation

### 3.1 General

#### 3.1.1 Controls

Table 3.1 contains a list of the operating controls and indicators located on the front panel.

#### 3.1.2 Procedures

After connecting the antenna and communication receiver, transfer the POWER switch to the ON position. No additional steps are required. The PAL-16 is now fully operational without further adjustment.

Table 3.1 Controls and Indicators

Power ON/OFF switch	Controls primary power application
POWER lamps	Lights when primary power is applied and switch is turned ON.
FUSE holder/indicator	Indicates failure of fuse by illumination of the fuseholder.
SPARE fuse	Two spare fuses are contained in spare fuseholders located on the front panel.
TRANSMIT indicator (option)	An LED indicator is provided on the front panel

## Section 4 - Principles of Operation

### 4.1 General

#### 4.1.1 Capabilities

The PAL-16 VHF/UHF Antenna Preamplifier is a broadband antenna preamplifier, designed to provide up to 25dB gain between the antenna and a communication receiver. The input and output impedance of the preamplifier is nominally 50 ohms. The standing wave ratio characteristic is better than 1.2-to-1 over the frequency range of 30-500MHz.

#### 4.1.2 Salient Performance Features

The preamplifier provides a nominal insertion gain of 25dB from the antenna input to the connected receiver depending on the loss characteristics of the coaxial feed cable. It is designed to ensure minimum noise generation, and to provide a high degree of intermodulation rejection. The applicable technical parameters for this equipment are listed in the Technical Specifications section of this manual (See Section 1.3).

#### 4.1.3 Equipment Structure

The PAL-16 preamplifier consists of three major sections as shown in Figure 4.1. These sections consist of the preamplifier/filter assembly in the RF path; the optional RF overload control assembly; and the regulated power supply.

### 4.2 Preamplifier

#### 4.2.1 Location and Features

The preamplifier is mounted on a printed circuit board which is securely fastened to a tin-plated steel module. It is a low-noise, wide-band amplifier having a 50-ohm impedance and a nominal voltage gain of 25dB. Figure 4.2 depicts its location in the mounting case.

#### 4.2.2 Power Distribution

Power for the preamplifier is derived from the internal +15vDC regulated power supply. This DC voltage is heavily decoupled to prevent distortion from the rectified power supply.

## 4.3 Power Supply and Regulator

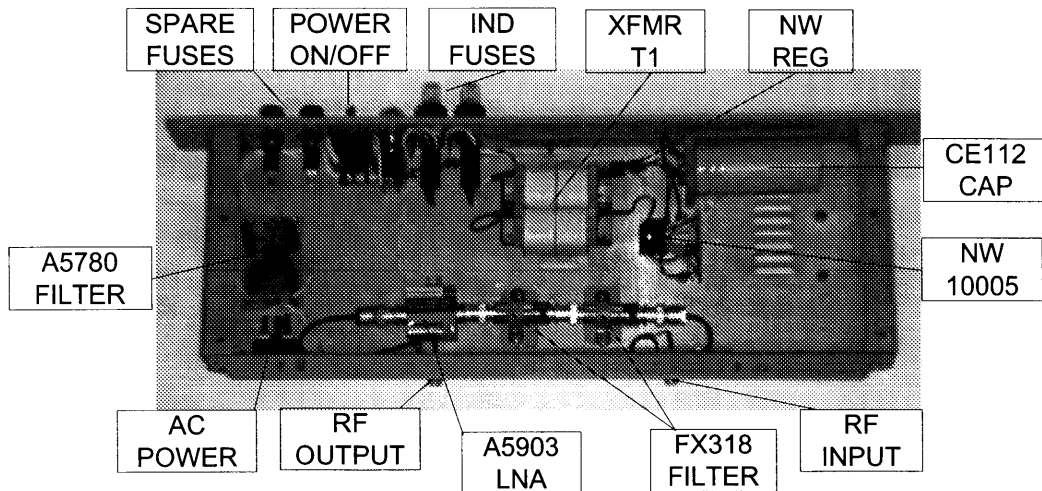
### 4.3.1 Location and Features

The components comprising the amplifier and power supply are all mounted to a standard 19-inch chassis panel.

### 4.3.2 Circuit Analysis

Primary power is supplied directly to the main power ON/OFF switch. When this switch is in the ON position, power is supplied through the two fuses FU102-3 to the power transformer T1 and the front panel indicator lamp DS1. The secondary of transformer T1 produces 29VAC, which is full-wave rectified by bridge rectifier NW10005, and filtered by capacitor CE112-15. The rectified AC output is regulated by a +15vDC network regulator and fed to a 0.1mf decoupling capacitor. This circuit segment presents a direct short to any RF coming from the antenna and prevents any low-frequency power supply hum from entering the RF path. The incoming RF is conducted from the INPUT BNC connector through the inline coaxial RF filters (optional) to the A5903 LNA preamplifier. Once amplified, the RF is presented at the OUTPUT BNC connector.

Figure 4.1 Component Location





# Section 5 - Maintenance

## 5.1 General

### 5.1.1 Test Equipment Requirements

This section describes preventive maintenance, trouble-shooting and repair procedures for the PAL. The following equipment is suggested in order to perform these procedure properly:

- RF Signal Generator, H/P Model 651B or equivalent
- Standard Volt-Ohmmeter

### 5.1.2 Component Location

For aid in the location of components, refer to Figures 4.1.

## 5.2 Preventive Maintenance

### 5.2.1 General Cleaning Methods

Preventive maintenance for the PAL-16 consists of routine functions such as visual inspection and cleaning. Periodic cleaning is recommended as dust may build up on components, reducing the efficiency of the coupler unit and possibly causing circuit failure. To facilitate cleaning the unit, use a vacuum cleaner or a low-pressure filtered compressed-air supply.

### 5.2.2 Visual Check and Adjustment

A simple visual check of the unit when it is opened up for servicing or cleaning with often reveal potential trouble spots and thereby reduce downtime due to component failure. Signs of trouble may be found in discoloration, warped printed circuit boards and damaged wiring or cables. Any deteriorating component should be replaced immediately. All hardware should be checked for tightness during preventive maintenance inspections.

## 5.3 Troubleshooting

### 5.3.1 General Failure Symptoms

During operation of the PAL-16, the following failure symptoms may be observed:

- No signal output from one or all receivers.
- Weak or noisy signals in one or all receivers.

### 5.3.2 Fault Localization

The primary objective of the troubleshooting procedure is to localize the fault to a particular section of the coupler unit. Table 5 provides a guide to locating and correcting the possible failures.

Table 5.1 - Troubleshooting Procedures

	<b>Symptom: No signal output at receiver</b>
Possible Cause:	Receiver failure
Remedial Action:	Refer to receiver manual
Possible Cause:	Interconnection, preamplifier to receiver
Remedial Action:	Check the RF cable between the receiver and preamplifier
Possible Cause:	Power supply failure
Remedial Action:	If POWER ON lamp is not illuminated, check for power input failure. If POWER ON lamp is on, checking indicating type fuses and replace with spare if necessary. If both fuses are intact, proceed to check of transformer, bridge rectifier and voltage regulator. +24VDC should be available at terminal of the regulator board.
Possible Cause:	Failure of preamplifier
Remedial Action:	If DC voltage is present at the output of the regulator and at the preamplifier, possible failure of a component in the preamplifier or failure in the input antenna circuit is indicated. For repair of the preamplifier, removal and testing of the module is necessary.
	<b>Symptom: Weak or noisy signals to receiver</b>
Possible Cause:	Antenna fault
Remedial Action:	Connect the antenna lead-in directly to the antenna input of the receiver. If the symptom persists, check for a fault in the antenna system.
Possible Cause:	Faulty preamplifier
Remedial Action:	If the cause is not attributable to the antenna, possible failure of a component in the preamplifier is indicated. Removal, testing and repair of the module necessary.

## 5.4 Repair

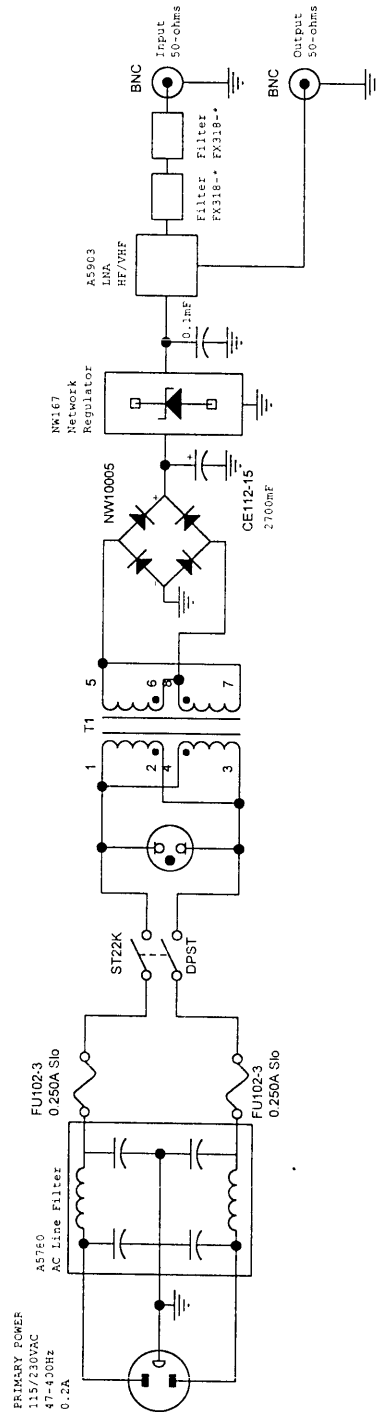
### 5.4.1 General Method

Repair work generally consists of replacing the defective component. The following cautions should be observed:

- Make sure the replacement component is an exact duplicate of the defective one. This is particularly important in the amplifier modules.
- Place any new component in the same location as the component it replaces. The dressing of any wire runs should not be altered.
- Observe standard practice when replacing semiconductor components by using a low-wattage soldering iron and appropriate heat-sink tools.
- Avoid damage to the printed circuit wiring when handling or repairing amplifier and regulator modules.

# Section 6 - Schematic Diagram and Parts

[Figure 6.1]



- \* KEY:
- EX318-1 Filter, IF, 40-75MHz
- EX318-2 Filter, LP, 150MHz
- EX318-3 Filter, HP, 100MHz
- EX318-4 Filter, LP, 200MHz
- EX318-5 Filter, HP, 150MHz

PRE-AMPLIFIER  
 RF Antenna, 50-ohm  
 PAL-16-1 45-60MHz  
 PAL-16-2 110-140MHz  
 PAL-16-3 150-170MHz