ITS *information transmission systems* CORPORATION

TECHNICAL MANUAL
EXHIBIT II

(PRELIMINARY)

6455A

BROADBAND TRANSLATOR

REV: 0

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McMurray, PA 15317 USA
Phone 412-941-1500
FAX 412-941-9421

☞WARNING!!!!!!

♦HIGH VOLTAGE♦

DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS UNIT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. EXERCISE CAUTION WHEN WORKING INSIDE THE UNIT. USE ONLY ONE HAND TO WORK WHEN SERVICING THE UNIT. IF POSSIBLE, TURN OFF THE POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.

■RADIO FREQUENCY RADIATION HAZARD■

MICROWAVE AMPLIFIERS AND TUBES GENERATE HAZARDOUS RF RADIATION WHICH CAN CAUSE SEVERE INJURY INCLUDING CATARACTS, RESULTING IN BLINDNESS. SOME CARDIAC PACEMAKERS MAY BE AFFECTED BY THE RF ENERGY EMITTED BY MICROWAVE AMPLIFIERS. NEVER OPERATE A MICROWAVE SYSTEM WITHOUT A PROPERLY MATCHED RF ENERGY ABSORBING LOAD ATTACHED. KEEP PERSONAL AWAY FROM OPEN WAVEGUIDES AND ANTENNAS. NEVER LOOK INTO AN OPEN WAVEGUIDE OR ENERGIZED ANTENNA. MONITOR ALL PARTS OF THE RF SYSTEM FOR RADIATION LEAKAGE AT REGULAR INTERVALS.

WARNING

VOLTAGES THAT ARE DANGEROUS TO LIFE ARE INVOLVED IN THE OPERATION OF THIS ELECTRONIC EQUIPMENT. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH VOLTAGES APPLIED. DANGEROUS CONDITIONS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM TO AVOID PERSONAL INJURY OR LOSS OF LIFE.

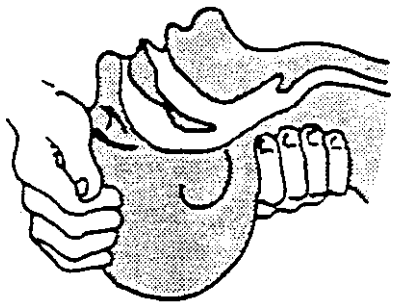
EMERGENCY
FIRST AID INSTRUCTIONS

Personnel engaged in the installation, operation, or maintenance of this equipment or similar equipment are urged to become familiar with the following rules both in theory and practice. It is the duty of all operating personnel to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

RESCUE BREATHING

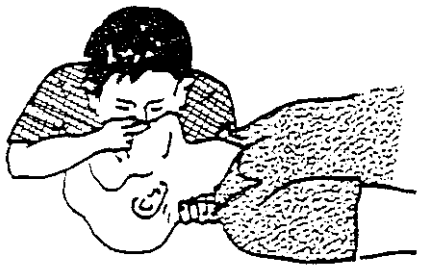
1. Find out if the person is breathing.

   You must find out if the person has stopped breathing. If you think he is not breathing, place him flat on his back. Put your ear close to his mouth and look at his chest. If he is breathing, you can feel the air on your cheek. You can see his chest move up and down. If you do not feel the air or see the chest move, he is not breathing.



2. If he is not, open the airway by tilting his head backward.

   Lift up his neck with one hand and push down on his forehead with the other. This opens the airway. Sometimes doing this will let the person breathe again by himself. If it does not, begin rescue breathing.



3. If he is still not breathing, begin rescue breathing:

   Keep his head tilted backward.
   Pinch his nose shut.
   Put your mouth tightly over his mouth.
   Blow into his mouth once every five seconds.
   Do Not Stop Rescue Breathing Until Help Comes.

LOOSEN CLOTHING – KEEP WARM

Do this when the victim is breathing by himself or help is available. Keep him quiet as possible and from becoming chilled. Otherwise, treat him for shock.

BURNS

SKIN REDDENED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Consult a physician.

SKIN BLISTERED OR FLESH CHARRED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

EXTENSIVE BURN-SKIN BROKEN: Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

6455A
BROADBAND TRANSLATOR

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DRAWING NUMBER SYSTEM

Each Assembly or subassembly is assigned an eight digit number.The fifth digit is the only number that changes in an assembly number. The change in this digit indicates the type of drawing assigned to it.

XXXX-1XXX COMPLETE ASSEMBLY, SUBASSEMBLY ON BOARD
XXXX-2XXX REPLACEMENT PARTS LIST
XXXX-3XXX SCHEMATIC OR BLOCK DIAGRAM
XXXX-5XXX PARTS LOCATION OR ASSEMBLY DRAWING
XXXX-7XXX CONTROL LOCATION DRAWING
XXXX-8XXX INTERCONNECT DRAWING

HOW TO USE THIS MANUAL

This manual is designed to aid the Engineer and/or Technician in the servicing and maintenance of the equipment described within. The paragraphs below describe each section of the ITS Instruction Manual and what is contained in them. Your particular manual may vary.

SYSTEM: Contains the description and drawings of the system along with the alignment, turn on, and operation procedures.

MAJOR ASSEMBLY: Contains the descriptions and drawings of the assembly along with the alignment, turn on, and operating procedures.

SUBASSEMBLIES: Includes circuit descriptions, schematics, drawings, and replacement parts lists.

HARNESS: Contains information on connectors and manufactures part numbers.

MAINTENANCE: Includes information on routine system checks and a log book to record system data.

TECHNICAL BULLETINS

ITS Corporation informs customers by mail as to any technical updates or additions to product maintenance programs. Place all updates in the maintenance section of this manual for future reference. You will receive one copy of each update. Please feel free to make as many copies as required to suit your needs.

TELEPHONE TECHNICAL SUPPORT

24 HOURS A DAY

If you have any questions concerning your ITS product, or need technical assistance, feel free to contact the ITS Service Company. A Customer Service Technician will be glad to assist you.

•During regular business hours of 8am to 5pm EST call (412) 941-1500. Your call will be answered by a voice mail system. Press 0 to reach an operator quickly.

After hours a beeper paging system is activated. Enter 777 if you are using a touch tone phone. Rotary caller dial (412) 571-7837.

Please leave a message that includes your name, phone number, and a brief description of the difficulty you are experiencing. A Customer Service Technician will contact you as soon as possible.

INSTALLATION PROCEDURE

UNPACKING

ITS Corporation certifies that upon leaving our facility, your equipment was undamaged and in proper working order. Please inspect all material upon arrival for any sign of damage. The shipping container should be examined for obvious damage indicative of rough handling. Remove the translator and all other material from the shipping container and check for damage: dents, large scratches, or broken connector etc. Open the translator and remove all packing material from inside the unit and inspect for damage. Any claims against in-transit damage should be directed to the Carrier.

SITE CONSIDERATIONS

Since the **ITS 715/716/717** is tray based, it must be mounted in a 19" equipment rack. This cabinet must be housed in an environmentally controlled cabinet or building. It is also very important to verify that adequate AC power is available.

AC LINE REQUIREMENTS ITS-715/716/717

ITS-715 10W TRANSLATOR	1/10A
ITS-716 20W TRANSLATOR	1/10A
ITS-717 50W TRANSLATOR	1/10A
ITS-716 w/ITS-750 100W Amplifier	1/20A

RACK MOUNTING

The **ITS-715/716/717** is designed to be mounted in a standard 19" equipment rack. Eight and 3/4 inches of rack space is required for each translator.

INSTALLATION PROCEDURE (continued)

Complete the following for equipment installation:

If the unit is supplied with a cabinet, carefully remove the cabinet from the shipping container. If the translator tray has been shipped separately, the internal shipping material must be removed from inside the cabinet before the tray is installed. Cut and remove the cable ties or cords which hold the tray harness breakouts to the tray slides. Carefully remove the foam packing material from around the cables, connectors and slides. Do **not** use a knife or other sharp object, as these may cut into the harness wires. Once the cabinet has been properly positioned, the trays can now be installed.

Extend the cabinet mounted slide rails out to their full and locked position. Place the tray with the slides into the cabinet slide rails until the tray locks into place. Press the side lock tabs on the rails to unlock the tray and carefully move the tray completely into the rack. Check that the cable breakouts in the rear are not caught on the tray as the tray is slid into place.

If the tray was shipped mounted in the cabinet, a front and rear shipping bracket must be removed in order to allow the tray to be pulled out.

If the tray does not slide in and out of the cabinet smoothly, loosen the hardware holding the slides in place. Move the tray accordingly and tighten the hardware again. Repeat if necessary until the tray slides in and out freely.

Next, secure the small cable retractors (attached to the main harness) to the back of the tray by sliding them into the clip located between the AC hook up and the fan on the back of the tray.

Connect the wires to the back of the tray. Each wire is marked with a number corresponding to the location where it should be connected to the back of the tray.

CABINET NOT SUPPLIED

Two tray slides are provided with the translator. Locate the left slide (without the cable retractor) and mount the slide to the left side of the cabinet (looking from the rear) using the supplied hardware. Refer to the Cabinet Mounting Diagram for further detail. Check that the slide is level from front to back.

NOTE: Allow a clearance of approximately 5 inches between the point from where the stationary section is attached to the cabinet slide and the rear cabinet mounting rail to permit proper operation of the cable retractors.

Install the remaining slide to the right side of the cabinet. Install the long retractor and hinge bracket to the stationary section of slide using the supplied hardware.

Extend the cabinet mounted slide rails out to their full and locked position. Place the tray with the slides into the cabinet slide rails until the tray locks into place. Press the side lock tabs on the rails to unlock the tray and carefully move the tray completely into the rack. Check that the cable breakouts in the rear are not caught on the tray as the tray is slid into place.

ADJUST TRAY ASSEMBLY.

Check to see that the tray slides freely with no interference from other assemblies. If not, some adjustment can be made by sliding the tray out, loosening the front or rear mounting bolts of the slide assemblies, and moving the tray in the direction required for smooth operation. After the adjustment has been made, firmly tighten the mounting bolts and check the movement again. Repeat if necessary.

INSTALL CABLE RETRACTOR ASSEMBLY.

The Cable Retractor Assembly consists of two parts: (A) a cabinet retractor and (B) a tray retractor.

A) The cabinet retractor consists of a short aluminum channel hinged to a mounting bracket that is to be placed on the right side (looking from the rear) of the cabinet slide assembly. Refer to the Cabinet Mounting Diagram for further detail.

B) The tray retractor is a short aluminum channel hinged to a slide bracket. The bracket slides down into the retractor receptacle which is located at the rear of the tray.

Both retractors work together to avoid pinching the wiring when the tray is moved in or out.

SYSTEM DESCRIPTION

The 6455A Boradband Translator is a multi-channel translator designed to be used by wireless cabel operators to provide MMDS/ITFS service without the added expense of a headend. The unit inputs multichannel superband (222 to 408 MHz) then upconverts and amplifies the signal to RF. The power capability of the unit varies with the number of channels according to specifications with a peak envelope power of 37.8 watts.

This manual covers the description, installation, set-up, operation, schematic and interconnect drawings, as well as other useful technical information.

SPECIFICATIONS: 6455A Broadband Translator

Type of Emissions ..... TRANSLATOR (Analog)
Frequency Range..... 2500 to 2690 MHz (any 6 MHz channel)
DC voltage and total current of final amplifier stage ..... 10 volts DC at 32.5 amps
(Class A - Not RF power dependent)
Total Output Power Rating..... 37.8 watts (peak envelope)
(6.3 watts total average)

Performance Specifications

Operating Frequency Range..... 2500 to 2686 MHz
RF Output - Nominal:
Impedance .....
Connector..... 50 Ω
Power:..... Type N
4 Channels.....1.58 W/channel
8 Channels..... 790 mW/channel
12 Channels ..... 525 mW/channel
16 Channels ..... 394 mW/channel
24 Channels ..... 263 mW/channel
31 Channels ..... 203 mW/channel

Nominal Input Signal Range (average power): ..... -32 to -17 dBm/Channel
Connector..... Type N
Impeadance..... 50 ohm

Out-of-Band Power ..... Per FCC Rules (21.908)
-25 dB max (at band edges):
-40 dB max (250.00 KHz above and 250.00 KHz below band edges):
-50 dB max (3.00 MHz above and 3.00 MHz below band edges):
-60 dB max (20.00 MHz above and 20.00 MHz below band edges):

Out-of-Band Power (Unoccupied Channel) ..... Per FCC Rules (21.908)
-25 dB max (at unoccupied channel edges)
-40 dB max (250.0 KHz above and 250.0 KHz below occupied channel edges)
-50 dB max (3.0 MHz above and 3.0 MHz below occupied channel edges)

Harmonic Products ..... -60 dB max

Electrical Requirements

Power Line Voltage ..... 60 VAC ±10%, 50/60 Hz

Power Consumption (System) ..... 1060 Watts

Environmental

Maximum Altitude (System) ..... 12,000 feet (3,660m)
Ambient Temperature (system)..... 0° to 50°C

Mechanical

Dimensions: (WxDxH)

Translator Tray ..... 19" x 21" x 8.75" (48.3cm x 53.3cm x 22.2cm)
Broadband Amplifier Tray ....19" x 30" x 10.25" (48.3cm x 76.2cm x 26.0cm)

Weight:

Translator Tray ..... 55 lbs. (24.9 kgs)
Broadband Amplifier Tray ..... 85 lbs. (38.6 kgs)

SYSTEM CHECK OUT AND OPERATION PROCEDURE

ELECTRICAL INTERFACE PROCEDURE

With the unit properly installed and adjusted in the equipment rack, the process of electrically interfacing the translator can begin. The following steps should be completed:

INSTALL AC LINE CORD.

Cabinet Supplied

For installations where the cabinet has been supplied, the AC line cord has been pre-wired into the main harness. Proceed to the section following "Cabinet not Supplied".

Cabinet Not Supplied

A line cord is provided with each translator tray. Insert the female connector of the line cord into the tray's AC input connector (J1). Make certain that the rear panel power switch is in the "OFF" position, then plug the line cord into an appropriate AC outlet to power the tray.

NOTE: The **ITS-715/716/717** was designed for either 117 VAC/60 Hz or 220 VAC 50 Hz. operation. It has been shipped from our factory properly configured for the standard of the country of destination. If you wish to change the AC configuration, please consult the factory.

CAUTION: **Never remove the RF output coaxial cables or otherwise unload the translator RF outputs while operating. This may cause harmful exposure to RF radiation.**

CONNECT RF OUTPUTS AND RF INPUTS:

Connect the output coaxial cables from the RF Output (J7) of the translator to the transmit antenna. Connect the RF input coaxial cable (J6) from the translator amplifier to the upconverter output (J5).

Connect the upconverter input (J4) to 138-324 MHz or 222-408 MHz (depending on model) cable feed. Connect 10 MHz input (J3) to 10 MHz reference if used.

INITIAL TURN ON PROCEDURE

Before beginning routine operation, the unit should be given a step-by-step check of its functions to verify proper interface and operation. This will give the operator a chance to become familiar with the unit. The following procedure should be followed for the initial turn-on of the unit:

1. APPLY AC POWER TO TRANSLATOR.

Move the translator rear panel AC switch to the **ON** position. The **THERMAL INTERLOCK** LED on the front panel will illuminate. This indicates that the thermal interlock is satisfied. If this is not the case, you should then refer to the troubleshooting section of this manual.

2. OPERATE TRANSLATOR

Move the translator to **OPERATE**. This should cause the **OPERATE** indicator to illuminate (if not, refer to troubleshooting section). Remove the tray's cover and observe the single LED indicator on the 1 Section Bias Protection Board (10 watt translator), or four LED indicators on the 4 Section Bias Protection Board (20 Watt translator), or the six LED indicators on the 6 Section Bias Protection Board (50 Watt translator). Each LED indicator should be illuminated indicating that all GaAs FET devices are operating properly.

3. MONITOR FORWARD OUTPUT POWER.

Now that the control and DC functions of the translator have been established as operative, move the translator metering select switch to the **FWD PWR.** (0-100%) position and verify that the meter indicates 100% on the **% POWER** (top scale) position of the meter.

NOTE: If the translator is being used as a driver, the meter reading on the add-on amplifier should indicate 100% while the translator will indicate a level less than 100%.

4. MONITOR REFLECTED POWER.

Move the translator metering select switch to the **REFL. PWR** (0-100%) position and verify that the meter typically indicates less than 10% on the **% POWER** scale.

5. MONITOR ALC

Move the translator metering select switch to the **ALC.** (0-10VDC) position and verify that the meter indicates about 2.5 VDC on the bottom scale.

6. RECORD LEVELS ON LOG SHEET

Once the translator is operating at full power, record all metered levels of the translator on a dated and initialed sheet. This sheet can be used for future comparison of the unit's operation. Comparing this information to the factory test data is always a good practice.

Normal Operation

Once the Installation and the Initial Turn-on are complete, operation is simple. With the AC ON/OFF switch in the **ON** position, the translator is activated by moving the **OPERATE/STANDBY** switch to **OPERATE**. This will now enable the translator. All of the green front panel operating status indicators should illuminate and the power metering should display a percentage of output power. To control the translator's output power, adjust the translator power control. To turn the translator off simply move the translator to **STANDBY** and turn the AC ON/OFF switch to **OFF**.

A problem with the translator will usually reveal itself by a loss (either total or partial) of power. If there is no power at the output of the tray, check to see that the AC switch is **ON** and the translator is in the **OPERATE** mode. If so, consult the troubleshooting section of this manual.

Small changes in the output power are acceptable, but if the translator must be adjusted 10 to 20 percent or more to maintain the desired output power, there may be a problem in the translator's amplifier section. Refer to the troubleshooting section of this manual.

1. ALC SET UP PROCEDURE

The output power of the translator is preset from the factory for an output level which corresponds to a Multi-channel Carrier to Composite Triple Beat (C/CTB) ratio that is equal to 55dB with carriers. If a different ratio of C/CTB is desired, the ALC can be manually adjusted to give a lower or greater output.

- With the translator in **operate**, turn the meter knob to ALC and observe the front panel meter. The meter should indicate 1-8 volts when the average output power level is within the effective operating range of the ALC circuitry.
- If the ALC voltage reading drops below 0 volts, this indicates that the input signal has risen above the ALC window and the yellow **overdrive** indicator which is on the front panel will light.
- If the ALC voltage exceeds 10 volts, this indicates that the input signal has fallen below the acceptable ALC window and the red **low output level** indicator will light.

If either extreme is the case, additional attenuation or preamplification may be needed to achieve the proper ALC range.

FRONT PANEL CONTROLS

The following controls and indicators are located on the front panel of the ITS-715/716/717 Translator:

FUNCTION	PURPOSE	TYPE OF DEVICE
OPERATE/STANDBY	ENABLES AND DISABLES THE TRANSLATOR	SWITCH
FORWARD POWER	INDICATES % OUTPUT POWER ON THE TOP METER SCALE	SELECTOR SWITCH/METER
REFLECTED POWER	INDICATES % OF REFLECTED POWER	SELECTOR SWITCH/METER
ALC	INDICATES ALC VOLTAGE (BOTTOM SCALE)	SELECTOR SWITCH/METER
THERMAL INTERLOCK	ILLUMINATION INDICATED THAT AN AMPLIFIER OVERTEMPERATURE FAULT IS NOT PRESENT	GREEN LED
LOW OUTPUT	ILLUMINATION INDICATES THAT THE OUTPUT IS BELOW NORMAL	RED LED
OVERDRIVE	ILLUMINATION INDICATES THAT THE OUTPUT IS ABOVE NORMAL	YELLOW LED
TRANSLATOR FAULT	ILLUMINATION INDICATES THAT A FAULT CONDITION EXISTS IN THE TRANSLATOR	RED LED
OPERATE	ILLUMINATION INDICATES THAT THE TRANSLATOR IS ENABLED	GREEN LED
STANDBY	ILLUMINATION INDICATES THAT THE TRANSLATOR IS DISABLED	YELLOW LED
PLL LOCK	ILLUMINATION INDICATES THAT THE VHF GENERATOR PLL IS LOCKED	GREEN LED
PLL REFERENCE	ILLUMINATION INDICATES THAT AN INTERNAL OR EXTERNAL REFERENCE SOURCE IS PRESENT	GREEN LED

INTERNAL INDICATORS

BOARD	REFERENCE	FUNCTION
A10- 1 SECTION BIAS BD. ITS-705	DS1 MODULE FAULT	ILLUMINATION INDICATES THAT AN OUTPUT AMPLIFIER FAULT IS NOT PRESENT
A10- 4 SECTION BIAS BD. ITS-706	DS1-DS4 MODULE FAULT	ILLUMINATION INDICATES THAT A DRIVER OR OUTPUT AMPLIFIER FAULT IS NOT PRESENT
A10- 6 SECTION BIAS BD. ITS-707	DS1-DS6 MODULE FAULT	ILLUMINATION INDICATES THAT A DRIVER OR OUTPUT AMPLIFIER FAULT IS NOT PRESENT
A17-ALC CONTROL BD.	DS1	ILLUMINATION INDICATES THAT ALC IS IN OPERATE
A3- ±12V POWER SUPPLY BD.	DS1-DS6	ILLUMINATION INDICATES PROPER OUTPUT FROM EACH ASSOCIATES REGULATOR.

MAINTENANCE

The ITS-715/716/717 Translator is designed with components that require little or no periodic maintenance.

Six LED indicators are located on the front panel to provide an indication of the translator's operating status. DS5, a green **operate** LED, indicates that the translator is in transmit and the **operate/standby** switch located on the front panel is in the **operate** mode. DS2, a red **low output level** LED, indicates that the output level is too low. DS3, a yellow **overdrive** LED, indicates that the amplifier stages within the translator are being over-driven which can cause distortion in the output signal. DS4, red **translator fault** LED, indicates that a fault condition exist with in the translator. DS1, green **thermal** LED, indicates that no amplifier is over temperature.

Periodically check that the exterior surface of the heatsink assembly is clean and that air flows freely through it. A thermal switch is provided within the translator assembly to furnish protection should a thermal condition arise. The switch is mounted directly to the heatsink assembly. A thermal condition will cause the thermal switch to close. This closure is sensed by the Transmitter Control Board which in turn disables the translator and de-energizes the Isolation Relay Board that provides 110 or 220 VAC to the +12 VDC Switching Power Supplies. The translator will remain disabled until the thermal condition is no longer present and normal operation will resume.

All boards and modules within the translator assembly can be removed without desoldering. To remove an amplifier module, disconnect the input and output SMA connectors using the small wrench supplied in the installation material kit. Disconnect the white Molex plug(s) associated to the module. Remove the screws securing the module to the heatsink along with the screw securing the ground lug to the module. The Six Section Bias Protection Board is removed by disconnecting TB1 from the Board, disconnecting the white Molex plug (J2,3,4) and removing the screws securing the board in place.

TELEPHONE TECHNICAL SUPPORT

To obtain technical assistance call (412) 873-8100 8am to 5pm EST.

Please prepare the following information before calling in order to receive the best service from your Customer Service Technician.

- Model Number
- When the problem started
- LED's, which are on? Off?
- Scope or meter readings
- Have this manual with you when placing the call.

During regular business hours your call is automatically answered by voice mail and options given. Press 0 to access an operator quickly.

After hours a beeper paging system is activated. Call (412) 873-8100. After voice mail answers enter 777 if you have a touch tone phone. Rotary phone callers dial (412) 571-7837.

Please leave a message that includes your name, phone number, and a brief description of the difficulty you are experiencing. A customer service technician will be contacted and return your call at his earliest opportunity.

Log Book Format

MODEL NUMBER: _____ SERIAL NUMBER: _____

DATE UNIT INSTALLED: _____ BY: _____

		DATE:			
		BY:			
METERING	**NORMAL**				
Forward Power	100%				
Reflected Power	<10%				
ALC	0-10VDC				
OPERATING STATUS INDICATORS					
PLL Lock	ON				
Thermal Interlock	ON				
Operate	ON				
Low Output	OFF				
Overdrive	OFF				
PLL Ref.	ON				
ADDITIONAL INDICATORS					
Translator Fault	OFF				
MISCELLANEOUS					
Fan Operation	OK				
Assembly Cleaned					
Room Temperature	77°F / 25°C				
AC Line Voltage	117 or 220 VAC				

RECORD OF REPAIRS AND OBSERVATIONS: (Indicate Dates, Operator and Technician.)

MAINTENANCE AND TROUBLESHOOTING

Problem Identification

The translator consists of several amplifier modules and supporting circuitry. If the driver stages are not at fault, first note the symptoms of the problem that is present. Most amplifier faults relate to low or no output power and/or signal quality problems. If there is no output power from the amplifier, first check to determine if the amplifier is being supplied the proper AC and control input commands. If the amplifier is operating but producing no output, check all of the LED indicators on the front panel and inside of the amplifier to determine if any of the green LEDs are not lit. If a green LED is found not lit, the troubled section of the system is most likely to be in that area. If all DC and control functions seem normal, it is necessary to quantify the performance problem and then determine the possible causes. **If an effort is being made to contact the factory to assist in problem identification, please record the status of all indicators, meter readings and signal quality measurements so that these important parameters may be related to the factory.**

Problem Analysis

In most cases, the performance of a GaAsFET transistor is closely tied to the DC operation of the system. Any degradation in signal quality, gain or power is usually related to a corresponding change in a DC parameter somewhere in the system. An exception may be a defective RF input or output connection which can result in poor performance of the amplifier with all DC parameters appearing normal.

The first step of analysis is therefore to carefully measure all DC parameters and compare these to the numbers indicated on the schematics, block diagrams, and factory test data sheet. The FLM2527 GaAsFETs operate at about +10 volts on the drain and bias at 4.8amps. Use the current sense resistors on the bias board to measure these currents. The FSX52 and FLL-171 located inside the 3 stage amplifier module operate at 75mA and 400mA. Use the current sense resistors located inside the 3 stage module to measure the current.

If all DC parameters are normal, an RF intermittency should be suspected. Follow the RF path from input to output and apply a small physical force on all connectors while observing the output power. If an intermittency is detected, a simple resoldering can be attempted.

While following these procedures, it is important to maintain terminations on all amplifier circuits to avoid VSWR damage. Before a fan fails, it normally begins to exhibit noisy operation. Always check for free fan blade movement and procure a replacement fan if fan bearing noise is evident.

Repair Procedures

Repair of this translator assembly normally involves module level replacement. ITS Corporation maintains an adequate stock of replacement modules. If you have determined that a particular subassembly is defective and that it cannot be easily repaired at your facility, please contact the ITS Customer Services Department. An effort will be made to provide a module on an exchange basis. It is often possible to ship replacement modules counter-to-counter or one-day UPS/Federal Express to expedite delivery.

REPAIR (continued)

On some occasions it is necessary to perform component level repairs. In many cases failures can be a result of poor connections somewhere in the system. Poor connections can generally be repaired with a suitable, small, grounded soldering iron. A spare parts kit of standard components is available for this translator. Please contact the ITS Marketing Department for the price and availability of the spare parts kit. Individual components can also be ordered from the Customer Services or Marketing departments of ITS. The fuses are standard and generally available at local parts distributors. The parts list provides complete manufacturer's information and part number for all standard electrical components. These components can often be obtained from local distributors. An effort has been made to select standard (off-the-shelf) components whenever possible in the product design. Replacement of the GaAsFET transistors in the field is not recommended unless performed by an experienced technician. It is important to realize that each GaAs FET operates at a specific bias voltage that must be preset before the main power supply is switched on. Failure to provide the proper bias voltage will result in rapid GaAsFET destruction. Please refer to the ITS Warranty and Material Return Authorization procedures for additional information concerning repair parts.

Periodic Procedures

This translator is designed with components that require no periodic maintenance except for cleaning and record keeping.

The amount of cleaning necessary depends greatly on the conditions in the translator room. While the electronics have been designed to function well even if covered with dust, heavy buildups of dirt and insects will impede the effectiveness of the cooling and lead to shutdown or premature failure.

When it is apparent that the front panel is becoming dust covered, the top cover should be opened and the accumulated foreign material removed. A small, soft brush used in conjunction with a plastic wand-like attachment on a small vacuum cleaner is an excellent way to remove dirt. Alcohol and other cleaning agents should not be used unless you are certain that the solvents will not damage components or markings. Water based cleaners can be used if only a small amount of moisture is used. The fans or heat sinks should be carefully cleaned.

Occasionally check that all RF connections are secure, but be careful not to overtighten.

Data should be recorded for all meter readings on a regular basis. It is suggested that data be recorded once each month and that it be retained in a rugged folder or envelope for the life of the equipment. A sample format of a log sheet is included at the end of this section. Photocopies of this sheet may be used for if desired.

Oscillator Calibration

The FCC requires that the local oscillator should be checked once each month. If the LO is found to be off frequency, the following procedure should be followed. The data resulting from this procedure should be logged for future reference. A frequency counter that is capable of 5×10^{-9} stability and a voltmeter are required.

1. CALCULATE LOCAL OSCILLATOR FREQUENCY

   A) Measure the VCXO frequency at J16 ($f_{(s)}$) on the VHF Generator Board (10 digits)

   B) Using a 10 digit calculator, perform the following calculation

$$LO = [\, 24 \times f_{(s)} \,]$$

   The result should be the desired LO frequency ±500 Hz (ITS Spec) or ±1000 Hz (FCC Spec)

2. MEASURE FREQUENCY OF OPTIONAL INTERNAL 5 or 10 MHz REFERENCE OSCILLATOR

Connect a frequency counter to J1 (5/10 MHz output SMA) which is located on the 5 or 10 MHz Reference Oscillator Assembly. Verify that the counter indicates 5 or 10 MHz. ±.9 Hz. Adjust C2 on reference oscillator if necessary for the exact frequency.

3. CALIBRATE VCXO LOOP RANGE

If the PLL is locked (DS1 not lit on the VHF Generator Board) connect a voltmeter between TP2 (probe) and chassis (ground lead) on the VHF Generator Board. The meter should indicate a reading from -2.5 to -3.5V. If the reading is not within this range, adjust C11 (coarse adjust) on the VHF Generator Board for a reading of 3.0 V. Connect a frequency counter to J16 ($f_{(s)}$) on the VHF Generator Board. Verify that the VCXO frequency is correct.
If the PLL is not locked or the desired voltage range at TP2 can not be obtained. please consult that factory.

TROUBLESHOOTING

Problem Identification

The first step in solving a problem with the translator is identifying the nature and location of the problem. Since the translator consists of many different boards and modules, it is often difficult to determine which part is causing the problem. The best method of isolating the problem is to divide the booster into three discrete sections and determining if these sections are operating correctly. The three sections are:

- Power Supplies
- Amplifier Modules
- ALC and Control Circuits

★First, check that all RF connections between the translator, cable feed, and antennas are correct and secure.

Note the symptom(s) of the problem that is present, including the status of the LED indicators located on the front panel. If the booster has no output, check that the **operate/standby** switch (S1), located on the front panel, is set to **operate**. If the translator remains inoperable, check the LED indicators within the translator and verify that all indicators are lit. If an indicator is found not to be lit, the fault is most likely to reside in the section associated with that indicator.

Refer to the diagnostic chart below for common symptoms and probable causes. Also refer to the translator Interconnect Drawing (1509-8100) and Block Diagram (1509-3100), for point-to-point troubleshooting assistance and signal level indications.

FRONT PANEL DIAGNOSTIC CHART

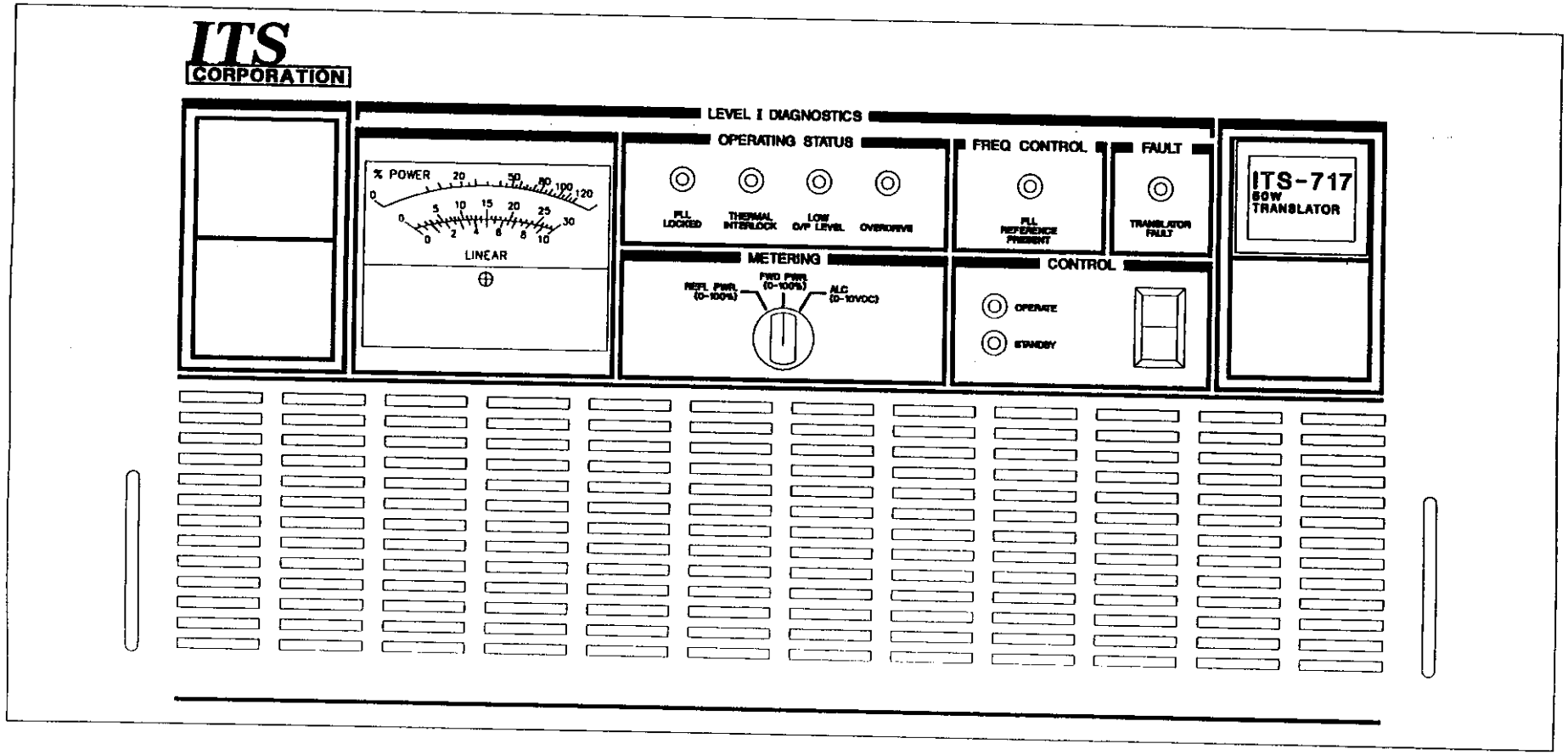
SYMPTOM	CHECK
DS5 GREEN OPERATE LED NOT LIT	**ON FRONT PANEL** 1. CHECK IF S2 IS IN OPERATE. 2. CHECK IF DS1 THERMAL INTERLOCK LED IS ON. IF OFF, A THERMAL PROBLEM EXISTS IN THE TRANSLATOR. **ON (A15) TRANSMITTER CONTROL BOARD** 1. CHECK J1-3.5 FOR ±12 VDC. CHECK DS1-6 ON ±12 VDC POWER SUPPLY BOARD. IF NOT LIT, CHECK F1 AND F2 FUSES.
DS2 RED LOW OUTPUT LEVEL LIT	**ON (A16) FRONT PANEL METER** **IMPORTANT: SET S1 TO ALC** 1. INDICATES ALC VOLTAGE ABOVE SET LEVEL. NORMALLY CAUSED BY LOW LEVEL INPUT. 2. CHECK THE INPUT LEVEL TO TRANSLATOR IS AT LEAST -35 dBm. **ON (A10) SIX SECTION BIAS PROTECTION BOARD (1500-1104)** 1. DS1 NOT LIT. INDICATES (A13-1) 3 STAGE AMPLIFIER MODULE (1500-1108) NOT OPERATING CORRECTLY. 2. DS2-6 IF NOT LIT. INDICATES (A13-2) 50 WATT AMPLIFIER MODULE (1500-1107) IS NOT OPERATING CORRECTLY.

FRONT PANEL DIAGNOSTIC CHART	
SYMPTOM	**CHECK**
DS3 YELLOW OVERDRIVE LED LIT	**ON (A16) FRONT PANEL METER** **IMPORTANT: SET S1 TO ALC** 1. ALC VOLTAGE BELOW ZERO, NORMALLY CAUSED BY A HIGH INPUT LEVEL. 2. CHECK THE INPUT LEVEL TO TRANSLATOR IS LESS THAN -20 dBm.
DS1 GREEN LED THERMAL INTERLOCK NOT LIT	CHECK THERMAL SWITCH (A13-3) MOUNTED ON THE HEATSINK OF THE AMPLIFIER MODULES. MODULES DRAWING TOO MUCH CURRENT. CHECK DS1 AND DS6 ON THE SIX SECTION BIAS PROTECTION BOARD. (SEE BELOW)
DS8 GREEN LED PLL LOCK NOT LIT	CHECK VHF GENERATOR BOARD FOR ±12 VDC. IF DS1 IS LIT, CHECK FREQUENCY.
DS7 GREEN LED PLL REFERENCE NOT LIT	CHECK VHF GENERATOR BOARD FOR 50KHz. CHECK 5 OR 10MHz OSCILLATOR.
DS4 RED TRANSLATOR FAULT LED LIT	CHECK FORWARD POWER READING (100%). CHECK DS1-DS6 ON 6 SECTION BIAS BOARD. CHECK FOR LOW RF INPUT AT J4.

Check the Level II Diagnostics LEDs located on the printed circuit boards within the translator. Refer to the Diagnostic Chart below for common symptoms and probable causes. Also refer to the translator Interconnect Drawing (1509-8100) and Block Diagram (1500-3100), for point-to-point troubleshooting assistance.

INTERNAL BOOSTER DIAGNOSTIC II CHART	
SYMPTOM	**CHECK**
DS1-6 GREEN LED ON SIX SECTION BIAS PROTECTION BOARD NOT LIT	CHECK FUSES F1-F6. CHECK VOLTAGE J2-1 AND J3-1,3,4,5,6, FOR +10 VDC. CHECK VOLTAGE AT TB1-1,4 FOR +10.2 VDC.
DS1-6 GREEN LED ON ±12 VDC NOT LIT	CHECK ±12 POWER SUPPLY BOARD (1500-1145) FOR +12 VDC. CHECK A3-J1-5 FOR +18 VDC. CHECK A2 BRIDGE RECTIFIER. CHECK FUSE F1.
DS6 -12 VDC GREEN LED ON ±12 VDC POWER SUPPLY BOARD	CHECK U6 FOR -12 VDC. CHECK AC VOLTAGE AT A3-J9-3 AND J9-1. CHECK FUSE F2.

★If factory assistance is needed in locating the problem, please record the status of all LED indicators, DVM readings and signal quality measurements so that these important parameters may be related to the Field Service Technician. Readings from the system before the problem occurred are also helpful to the Customer Service Technician.



NOTE: UNIT SHOWN ABOVE IS 50 WATT VERSION.

ITS CORPORATION	REV	ECN	DATE	APV

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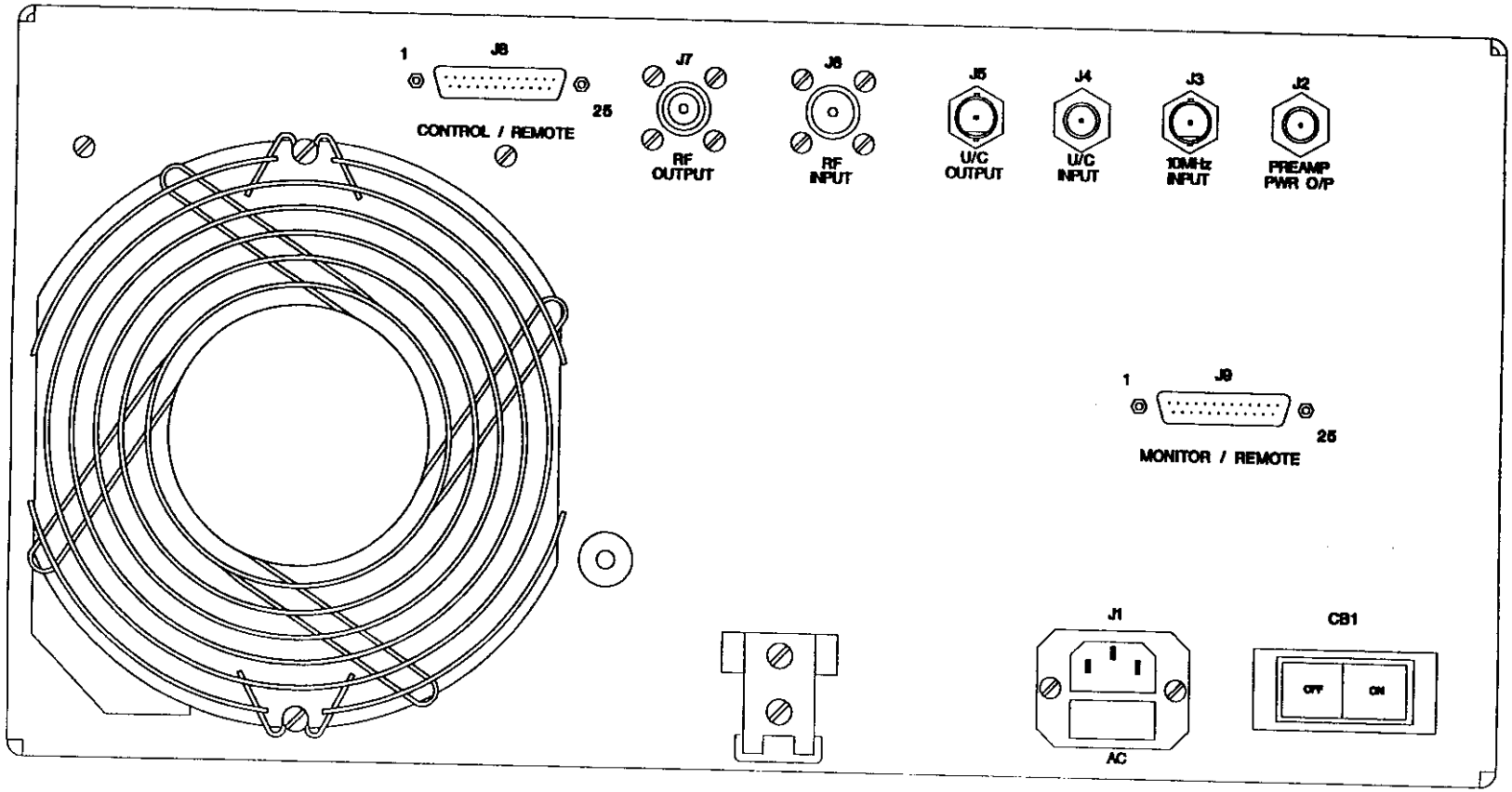
MATERIAL ------

FINISH ------

TITLE: FRONT PANEL VIEW, ITS-717 10/20/50 WATT TRANSLATOR

			DWG. NO.	REV
DWN	CAE	11-11-94	1509-7003	P0
CHK				
REL				

C SCALE 1:1 SHEET 1 OF 1



ITS CORPORATION	REV	ECN	DATE	APV
THIS PRINT IS THE PROPERTY OF ITS CORP. IT SHALL NOT BE COPIED WITHOUT PERMISSION.	TITLE: REAR PANEL VIEW, ITS-715/16/17 TRANSLATOR			
MATERIAL: ---	DWN: CML 10-24-94	DWG. NO.: 1509-7004	REV: 0	
FINISH: ---	CHK: KEF 03-01-94			
	REL: KEF 03-01-94	C	SCALE: 1:1	SHEET 1 OF 1

RELEASED FOR PROD. CML
0 --- 03/01/95 KEF
REV ECN DATE APV

6455A
BROADBAND TRANSLATOR

TRANSLATOR TRAY
DRAWING LIST (SUBASSEMBLIES)

6455A
BROADBAND TRANSLATOR

BROADBAND AMPLIFIER TRAY
DRAWING LIST (SUBASSEMBLIES)

Power Detector/Control Board 1586-1118
Schematic 1586-3118

25 Watt Power Amplifier Assembly 1586-1117
Interconnect 1586-8117

The 25 Watt Amplifier Assembly consist of the following boards/modules:

---

25 Watt Amplifier Module 1585-1266
Schematic 1585-3266

Amplifier Daughter Board 1512-1110
Schematic 1512-3110

8 Section Bias Protection Board 1586-1109
Schematic 1585-3109

DC to DC Converter Board
Schematic ITS-DT380-11

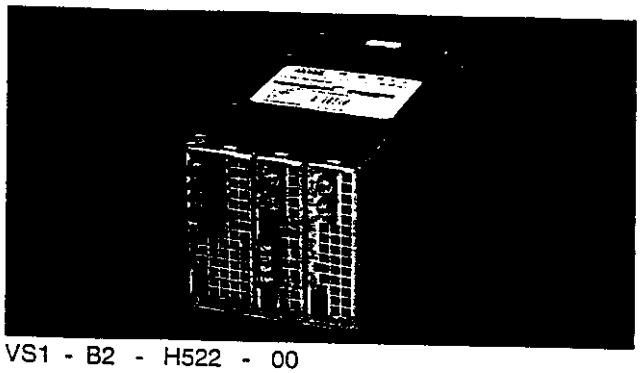
The Power Factor Corrected Front End Module consist of the following power supplies:

PFC 200W Supply ..... (VS3) 73-450-0001

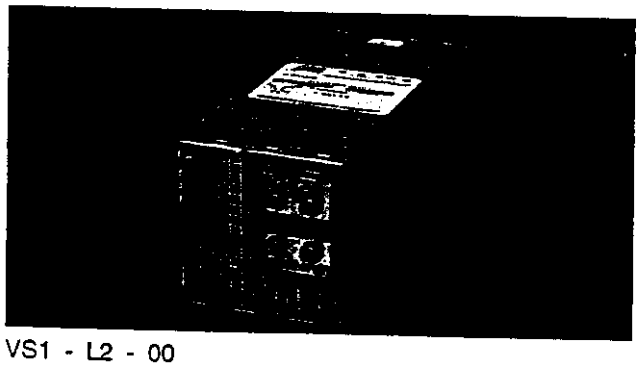
40W Switching Supply LPS23

80W Switching Supplu LPS63

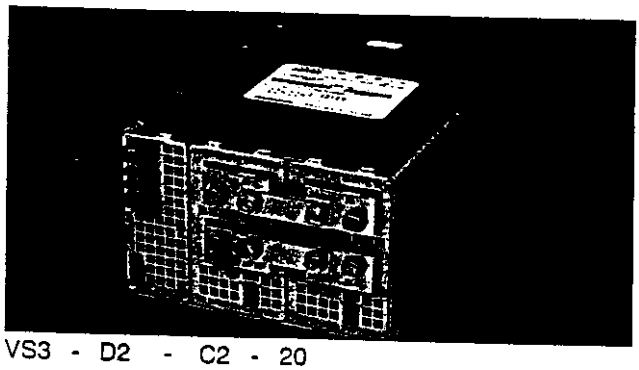
VS SERIES
800-2000 WATTS



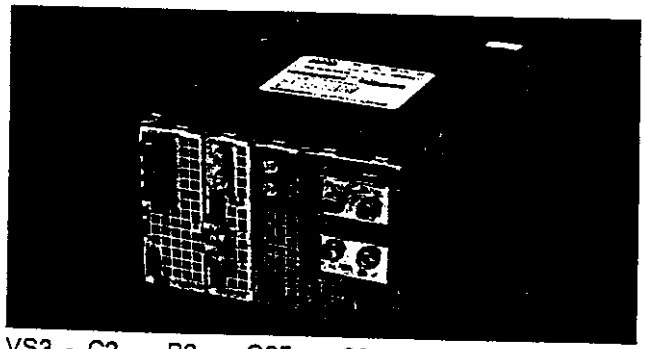
VS1 - B2 - H522 - 00
(600W) (500W)..... 1100W total



VS1 - L2 - 00
(1500W)..... 1500W total



VS3 - D2 - C2 - 20
(1200W) (900W)..... 2000W max total



VS3 - C2 - B3 - G25 - 00
(900W) (600W) (500W)..... 2000W total

VS Series
800-2000 Watts • 1 to 12 Outputs

VS is the first full-featured high power product with a PFC front end as a standard input. It is available in both single and multiple output versions with over one million different output combinations as standard. Offering a very compact footprint, the 1500 watt package measures 5" x 5" x 11", and the 2000 watt package measures 5" x 8" x 11".

SPECIAL FEATURES

- Power factor correction
- IEC 555-2 harmonic distortion compliance
- CISPR 22, EN55022 Level B conducted / radiated EMI
- IEC 801 immunity standards
- European CE Mark
- Current share on all outputs
- Remote sense on all outputs
- Overload protection on all outputs
- Voltage adjustment on all outputs
- Margining on all outputs
- AC OK signal (two logics)
- Global DC OK (two logics)
- DC OK signal and status indicator LED on all outputs
- Global and individual module inhibits/enable
- 3 year warranty

SAFETY

UL	UL1950
CSA	CSA22.2 - 950
IEC	IEC950, Class 1
VDE	EN60950
TUV	EN60950

FILE NUMBERS

UL	E133211
CSA	LR42001B
VDE	79579 & 79580
TUV	R9272192 & R9272191

ENVIRONMENTAL

Operating temperature: -10°C to 50°C (derate each output linearly to 60% at 70°C) 40°C max for reverse air (option #1)

Shock/Vibration: Mil-Hdbk 810E

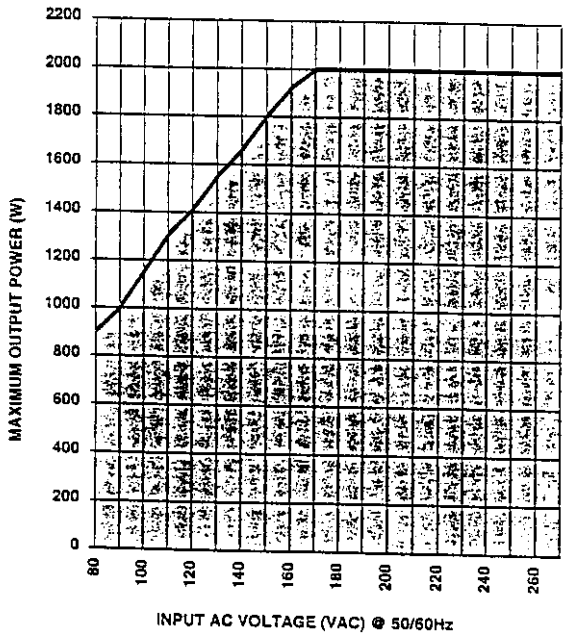
Humidity: 95% non-condensing

Storage temperature: -55°C to +85°C

Temperature coefficient: 0.02% per °C

Cooling: Internal DC fan 24V

Operating Envelope



For example, 1400 watts is the maximum power that can be achieved at 120 VAC.

For application information, see Application Note D1 or PowerFAX Doc. no 1159.

ELECTRICAL SPECIFICATIONS

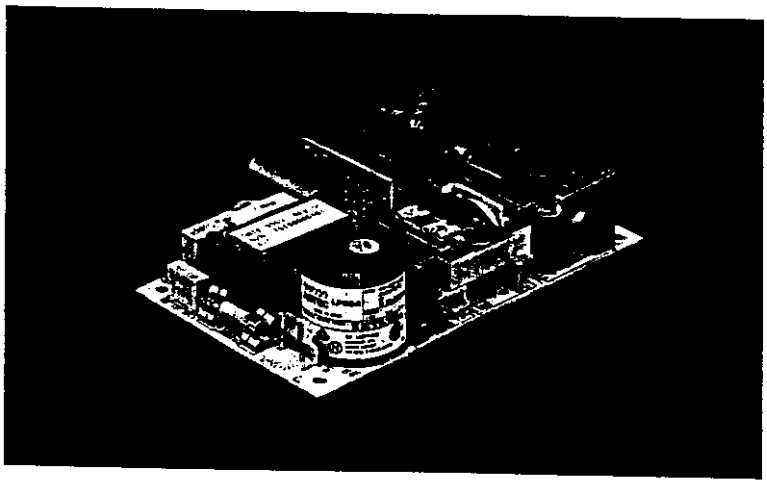
Input

Fuse rating	600 V/25 A (internal)
Input voltage	85 to 264 VAC; See operating curve
Frequency	47 to 440 Hz
Inrush current	40 A peak max
Efficiency	75% - 82%
Power factor	0.99 typical
Turn-on time	AC / 1 sec; Inhibit / 100 ms max
EMI filter	CISPR 22, EN55022 Level B conducted/radiated
Leakage current	2 mA max at 264 VAC
Holdover storage	20 ms minimum/40 ms typical independent of VAC
AC OK warning time	> 5ms (power fail)

Output

Adjustment range	± 10% minimum
Margining	± 4-6% nominal
Line/load reg	0.2% or 5 mV max
Ripple	RMS: 0.1% or 10 mV P-P: 1.0% or 50 mV Bandwidth limited to 20 MHz
Dynamic response	2% or 100 mV with 25% load step (any output)
Recovery time	To within 1% in < 300µsec
Overvoltage protection	2 to 5 V 122% to 134% of output voltage; 12 to 28 V 110% to 120%; recycle AC
Overload protection	Main: 105% to 120% of rated current Auxiliaries: 105% to 140%
Short circuit protection	Protected for continuous short circuit, recovery automatic
Reverse voltage protection	100% of rated output current
Thermal protection	Each module thermally protected. Input module: auto recovery. Output modules; recycle AC.
Remote sense	Up to 0.5 V total drop
Single wire parallel	Current share to 2% of total rated current
Switching frequency	200 KHz(900-1500 watt module, 400 KHz)
DC OK	-2% to -6% of nominal

LPS 25
25 WATTS



LPS Series
25 Watts • Single Output

The LPS Series of power supplies is an AC/DC universal input, single output design offering the latest in high technology performance. This rugged PCB design measures only 3" x 5" and features Class B EMI, high efficiency, and very high reliability. The LPS Series is ideal for telecommunication and computer peripheral applications, test and industrial equipment, medical instrumentation, and business machines.

SPECIAL FEATURES

- Universal input
- High efficiency
- Remote sense
- Built-in EMI filter
- Low output ripple
- Adjustable output
- Overvoltage protection
- Overload protection
- Enclosure kit available (see page 27 or PowerFAX Doc. no 1025)

ENVIRONMENTAL

Operating temperature:
0° to 50°C ambient; derate each output at 2.5% per degree from 50° to 70°C

Electromagnetic susceptibility: designed to meet IEC 801,-2, -3, -4, -5, -6, Level 3

Humidity: Operating; non-condensing 5% to 95%

Vibration: Three orthogonal axes, sweep at 1 oct/min, 5 min. dwell at four major resonances 0.75G peak 5 Hz to 500 Hz, operational

Storage temperature: -40° to 85°C

Temperature coefficient: ± .04% per degree C

MTBF demonstrated: > 550,000 hours at full load and 25°C ambient conditions

ELECTRICAL SPECIFICATIONS

Input

Input range	85 VAC to 264 VAC; 120 to 370 VDC
Frequency	47 - 440 Hz
Inrush current	< 15 A peak @ 115 VAC; < 30 A peak @ 230 VAC, cold start @ 25°C
Input current	1 A max. (RMS) @ 115 VAC
Efficiency	70% typical at full load
EMI filter	FCC Class B conducted, CISPR 22 Class B conducted, EN55022 class B conducted and VDE 0878 PT3 class B conducted
Safety ground leakage current	< 0.5mA @ 50/60Hz. 264 VAC input

Output

Maximum power	25 W for convection; 40 W with 30 CFM forced air
Adjustment range	-5, +10% minimum
Hold-up time	20 ms at 25 watt load and 115 VAC nominal line
Overload protection	Short circuit protection on all outputs. Case overload protected @ 110% to 145% above peak rating
Overvoltage protection	5V output: 5.7 to 6.7 VDC. Other outputs 10% to 25% above nominal output

SAFETY & FILE NUMBERS

VDE	0805/EN60950 (IEC950)	11774-3336-1241 (LC#84936)
UL	UL1950	E132002
CSA	CSA 22.2-234 Level 3	LR53982C
NEMKO	EN 60950/EMKO-TUE (74-sec) 203	P95100442
BABT	EN60950/BS7002	PS/605316
CB	Certificate and report	1577, 1578, 1579, 1580
CE	Mark	

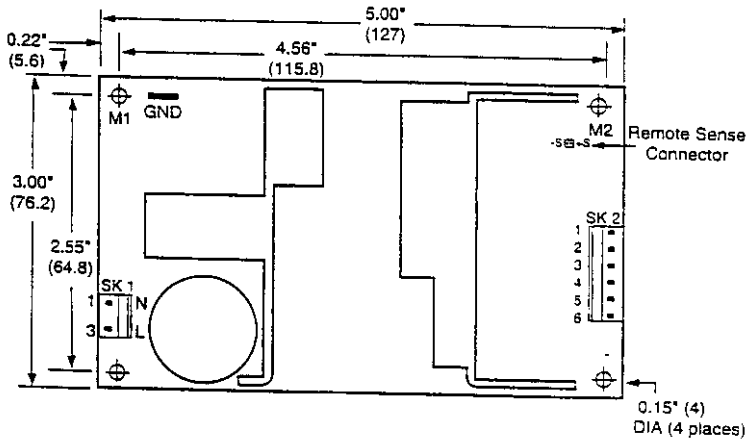
ORDERING INFORMATION

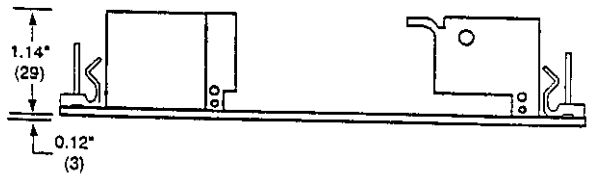
Model Number	Output Voltage	Minimum Load	Maximum Load with Convection Cooling	Maximum Load with 30 CFM Forced Air	Peak Load[1]	Regulation[2]	Ripple P/P (PARD)[3]
LPS22	5 V	0 A	5 A	8 A	9 A	± 2%	50 mV
LPS23	12 V	0 A	2.1 A	3.3 A	3.7 A	± 2%	120 mV
LPS24	15 V	0 A	1.7 A	2.7 A	3 A	± 2%	150 mV
LPS25	24 V	0 A	1.1 A	1.8 A	1.9 A	± 2%	240 mV

1. Peak current lasting < 30 seconds with a maximum 10% duty cycle.
2. At 25°C including initial tolerance, line voltage, load currents and output voltages adjusted to factory settings.
3. Peak-to-peak with 20 MHz bandwidth and 10 µF in parallel with a 0.1 µF capacitor at rated line voltage and load ranges.

LOW

DRAWINGS





PIN ASSIGNMENTS

Connector	LPS22	LPS23	LPS24	LPS25
SK1-1	Neutral	Neutral	Neutral	Neutral
SK1-3	Line	Line	Line	Line
SK2-1	+5 V	+12 V	+15 V	+24 V
SK2-2	+5 V	+12 V	+15 V	+24 V
SK2-3	+5 V	+12 V	+15 V	+24 V
SK2-4	Common	Common	Common	Common
SK2-5	Common	Common	Common	Common
SK2-6	Common	Common	Common	Common

MATING CONNECTORS

AC Input: Molex 09-50-8031 (USA)
09-91-0300 (UK)
PINS: 08-58-0111

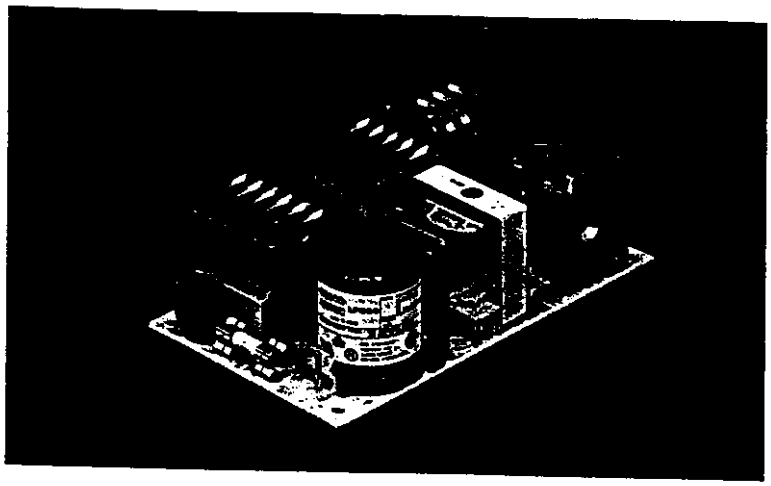
DC Outputs: Molex 09-50-8061 (USA)
09-91-0600 (UK)
PINS: 08-58-0111

Remote Sense: 22-01-2025

NOTES

1. Specifications subject to change without notice.
2. All dimensions are in inches and (mm), tolerance is ± .01".
3. Mounting holes M1 and M2 should be grounded for EMI purposes.
4. Mounting hole M1 is safety ground connection.
5. Specifications are for convection rating unless otherwise stated.
6. Warranty: 1 year
7. Weight: 0.5 lb / 0.23 kg

LPS 60
60 WATTS



LPS Series
60 Watts • Single Output

The LPS Series of power supplies is an AC/DC universal input, single output design offering the latest in high technology performance. This rugged PCB design measures only 3" x 5" and features Class B EMI, high efficiency, and very high reliability. The LPS Series is ideal for telecommunications and computer peripheral applications, test and industrial equipment, medical instrumentation, and business machines.

SPECIAL FEATURES

- Universal input
- High efficiency
- Remote sense
- Built-in EMI filter
- Low output ripple
- Adjustable output
- Overvoltage protection
- Overload protection
- Enclosure kit available (see page 28 or PowerFAX Doc. no 1025)

ENVIRONMENTAL

Operating temperature:
0° to 50°C ambient; derate each output at 2.5% per degree from 50° to 70°C

Electromagnetic susceptibility: designed to meet IEC 801,-2, -3, -4, -5, -6, Level 3

Humidity: Operating; non-condensing 5% to 95%

Vibration: Three orthogonal axes, sweep at 1 oct/min, 5 min. dwell at four major resonances 0.75G peak 5 Hz to 500 Hz, operational

Storage temperature: -40° to 85°C

Temperature coefficient: ± .04% per degree C

MTBF demonstrated: > 550,000 hours at full load and 25°C ambient conditions

ELECTRICAL SPECIFICATIONS

Input

Input range	85 VAC to 264 VAC; 120 to 370 VDC
Frequency	47 - 440 Hz
Inrush current	< 18 A peak @ 115 VAC; < 36 A peak @ 230 VAC; cold start @ 25°C
Input current	1.5 A max. (RMS) @ 115 VAC
Efficiency	70% typical at full load
EMI filter	FCC Class B conducted, CISPR 22 Class B conducted, EN55022 class B conducted and VDE 0878 PT3 class B conducted
Safety ground leakage current	< 0.5mA @ 50/60Hz, 264 VAC input

Output

Maximum power	60 W for convection; 80 W with 30 CFM forced air
Adjustment range	-5, +10% minimum
Hold-up time	20 ms at 60 watt load and 115 VAC nominal line
Overload protection	Short circuit protection on all outputs. Case overload protected @ 110% to 145% above peak rating
Overvoltage protection	5V output: 5.7 to 6.7 VDC. Other outputs 10% to 25% above nominal output

SAFETY

VDE	0805/EN60950 (IEC950)	11774-3336-1255 (LC #86665)
UL	UL1950	E132002
CSA	CSA 22.2-234 Level 3	LR53982C
NEMKO	EN 60950/EMKO-TUE (74-sec) 203	P95100123
BABT	EN60950/BS7002	PS / 605272
CB	Certificate and report	1521, 1522, 1523, 1524
CE	Mark	

ORDERING INFORMATION

Model Number	Output Voltage	Minimum Load	Maximum Load with Convection Cooling	Maximum Load with 30 CFM Forced Air	Peak Load[1]	Regulation[2]	Ripple P/P (PARD)[3]
LPS61	3.3V	0A	12A	16A	18A	± 2%	33 mV
LPS62	5 V	0 A	12 A	16 A	18 A	± 2%	50 mV
LPS63	12 V	0 A	5 A	6.7 A	7.5 A	± 2%	120 mV
LPS64	15 V	0 A	4 A	5.3 A	6 A	± 2%	150 mV
LPS65	24 V	0 A	2.5 A	3.3 A	3.8 A	± 2%	240 mV
LPS68	48V	0A	1.3A	1.7A	1.9A	± 2%	480 mV

1. Peak current lasting < 30 seconds with a maximum 10% duty cycle.
2. At 25°C including initial tolerance, line voltage, load currents and output voltages adjusted to factory settings.
3. Peak-to-peak with 20 MHz bandwidth and 10 µF in parallel with a 0.1 µF capacitor at rated line voltage and load ranges.

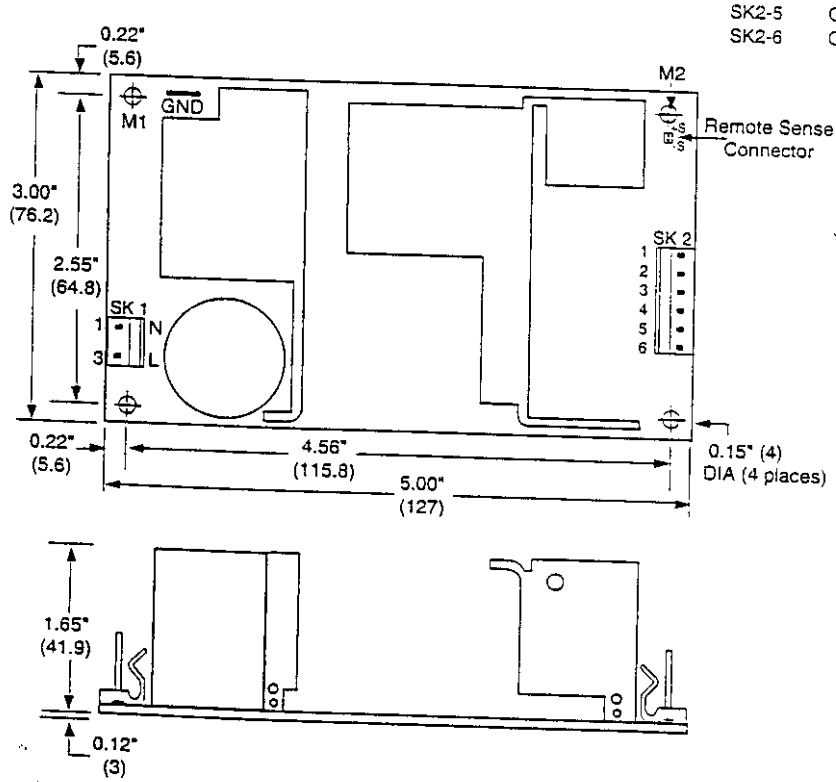
$33.00/1000 $45.00/100

$32.00/500 $65.00/Piece

PIN ASSIGNMENTS

Connector	LPS61	LPS62	LPS63	LPS64	LPS65	LPS68
SK1-1 SK1-3	Neutral Line	Neutral Line	Neutral Line	Neutral Line	Neutral Line	Neutral Line
SK2-1	3.3V	+5 V	+12 V	+15 V	+24 V	48V
SK2-2	3.3V	+5 V	+12 V	+15 V	+24 V	48V
SK2-3	3.3V	+5 V	+12 V	+15 V	+24 V	48V
SK2-4	Common	Common	Common	Common	Common	Common
SK2-5	Common	Common	Common	Common	Common	Common
SK2-6	Common	Common	Common	Common	Common	Common

DRAWINGS



MATING CONNECTORS

AC Input: Molex 09-50-8031 (USA)
09-91-0300 (UK)
PINS: 08-58-0111

DC Outputs: Molex 09-50-8061 (USA)
09-91-0600 (UK)
PINS: 08-58-0111

Remote Sense: 22-01-2025

NOTES

1. Specifications subject to change without notice.
2. All dimensions are in inches and (mm), tolerance is ± .01".
3. Mounting holes M1 and M2 should be grounded for EMI purposes.
4. Mounting hole M1 is safety ground connection.
5. Specifications are for convection rating unless otherwise stated.
6. Warranty: 1 year
7. Weight: 0.75 lb./0.34 kg

MAINTENANCE

This product is designed with components that require no periodic maintenance except for cleaning and record keeping.

The amount of cleaning necessary depends greatly on the conditions in the transmitter room. While the electronics have been designed to function well even if covered with dust, heavy buildups of dirt and insects will impede the effectiveness of the cooling and lead to shutdown or premature failure.

When it is apparent that the front panel is becoming dust covered, the top cover should be opened and the accumulated foreign material removed. A small, soft brush used in conjunction with a plastic wand-like attachment on a small vacuum cleaner is an excellent way to suction the dirt out. Alcohol and other cleaning agents should not be used unless you can be certain that the solvents will not damage components or markings on the transmitter and boards. Water based cleaners can be used, if only a small amount of moisture is used. The fans and heatsinks should be cleaned carefully.

Occasionally check that all RF connections are secure, but be careful not to overtighten.

Data should be recorded for all meter readings on a regular basis. It is suggested that data be recorded once each month and that it be retained in a rugged folder or envelope for the life of the equipment. A sample format of a log sheet is included at the end of this section. Photocopies of this sheet may be used for log purposes if desired.

PROBLEM ANALYSIS

In most cases the performance of a GaAs FET transistor is closely related to the DC operation of the system. Any degradation of signal quality, gain or power is usually related to a corresponding change in a DC parameter somewhere in the system. An exception may be a defective RF input or output connection which can result in poor performance of the amplifier with all DC parameters appearing normal.

The first step of analysis is therefore to carefully measure all DC parameters and compare these to the numbers indicated on the schematics, block diagrams and factory test data sheet. Each GaAs FET operates with = -5V of bias on the gate and +10.2V maximum on the drain. The static current of a GaAs FET is determined by measuring across the associated .05 ohm resistor, located on the bias protection board, and using ohm's law. If all DC parameters are normal, an RF intermittency should be suspected. Follow the RF path from input to the output and apply a small physical force on all connectors while observing the output power. If an intermittency is detected, a simple resoldering can be attempted. While following these procedures, it is important maintain terminations on all amplifier circuits to avoid VSWR damage.

This transmitter contains a fan for cooling purposes. These fans have enclosed bearings that require no external lubrication. Periodically check the fans for free blade movement and also clean the fans as needed. Before a fan fails, it will normally begin to exhibit noisy operation. Obtain a replacement fan if needed. Do not operate the transmitter for a long period of time if one of the fans fail.

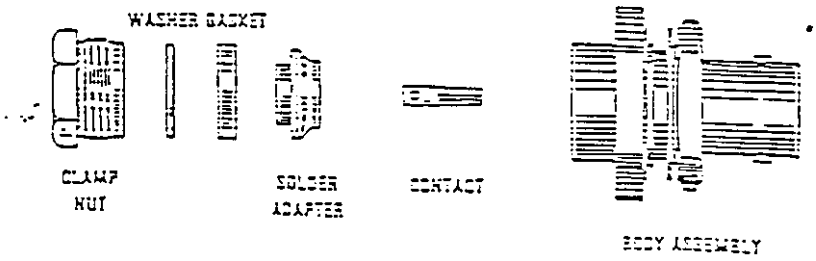
REPAIR PROCEDURES

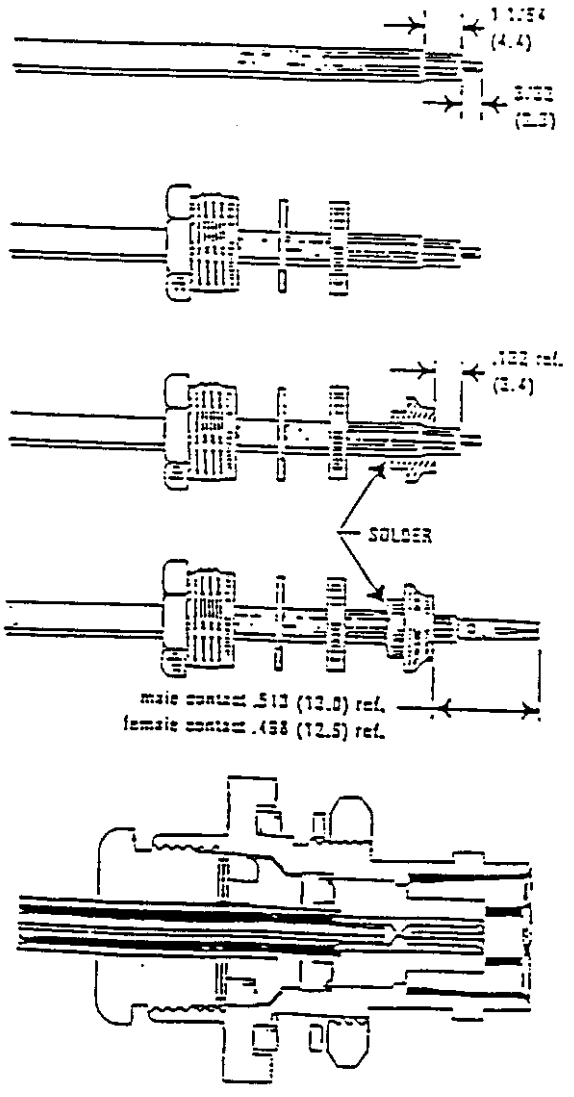
Repair of this transmitter assembly normally involves module level replacement. ITS Corporation maintains an adequate stock of replacement modules. If you have determined that a particular subassembly is defective and that it cannot be easily repaired at your facility, please contact the ITS Service Company. An effort will be made to provide a module on an exchange basis. It is often possible to ship replacement modules counter-to-counter or one-day UPS/Federal Express to expedite delivery.

On some occasions it is necessary or desirable to effect component level repairs. In many cases, failures can be a result of poor connections somewhere in the system. Poor connections can generally be repaired with a suitable, small, grounded soldering iron. A spare parts kit of standard components is available for this transmitter. Please contact the ITS Microwave Marketing Department for the price and availability of the spare parts kit. Individual components can be ordered from Microwave Marketing Departments of ITS. The fuses are standard and generally available at local parts distributors. The parts lists in this manual provide complete manufacturer's information and part numbers for all standard electrical components. These components can often be obtained from local distributors. An effort has been made to select standard (off-the-shelf) components whenever possible in the product design. Replacement of the GaAs FET devices in the field is not recommended, although with special factory instructions, it can be successfully accomplished. It is important to realize that each GaAs FET operates at a specific bias voltage that must be preset before the main power supply is turned on. Failure to provide the proper bias voltage will result in rapid GaAs FET destruction.

BNC ASSEMBLY INSTRUCTIONS

SOLDER-TYPE





Trim cable square, deburn and clean copper jacket 5/8" (15.9) minimum. Strip to dimensions shown.

Slide clamp nut, washer and gasket over cable jacket as shown.

Slide solder adapter into position over cable so that outer conductor bottoms on internal shoulder. Solder as shown. Avoid excessive heat which may deform dielectric. After assembly has cooled, verify dimension shown and trim dielectric if necessary.

Solder center contact to inner conductor. Center contact must seat square against dielectric. Again, avoid excessive heat which may deform dielectric. Verify dimension shown to assure mechanical and electrical integrity of assembly.

Insert cable assembly into body assembly. Move gasket and washer into position and tighten clamp nut.

BLACK/WHITE CONTACT HOUSINGS (1058-2020)

DESCRIPTION	PART NO.	MANUFACTURER
This first group of items refers to the small, black plugs that connect to boards.		
Plug - 2 Pos. - .1" Ctrs.	87499-3	AMP
Plug - 3 Pos. - .1" Ctrs.	87499-5	AMP
Plug - 4 Pos. - .1" Ctrs.	87499-7	AMP
Plug - 5 Pos. - .1" Ctrs.	87499-9	AMP
Plug - 6 Pos. - .1" Ctrs.	1-87499-1	AMP
Plug - 7 Pos. - .1" Ctrs.	87499-1	AMP
Plug - 8 Pos. - .1" Ctrs.	1-87499-3	AMP
Plug - 9 Pos. - .1" Ctrs.	1-87499-5	AMP
Plug - 10 Pos. - .1" Ctrs.	1-87499-7	AMP
Plug - 11 Pos. - .1" Ctrs.	1-87499-9	AMP
Plug - 12 Pos. - .1" Ctrs.	2-87499-1	AMP
Female Receptacle for .1" Ctrs. Plugs	1-87309-4	AMP
Keying Plug for .1" Ctrs. Plugs	87077-2	AMP
Hand Tool	90845-1	AMP
This second group of items refers to the larger white plugs which also connect to boards.		
Plug - 4 Pos. - .156" Ctrs.	1-87025-3	AMP
Plug - 5 Pos. - .156" Ctrs.	2-87025-3	AMP
Plug - 8 Pos. - .156" Ctrs.	1-87025-6	AMP
Plug - 10 Pos. - .156" Ctrs.	1-87025-8	AMP
Plug - 12 Pos. - .156" Ctrs.	1-87025-2	AMP
Plug - 14 Pos. - .156" Ctrs.	3-87025-8	AMP
Female Receptacle for .156" Ctrs.	102104-2	AMP
Keying Plug for .156" Ctrs. Plug	87116-2	AMP
Hand Tool	90274-2	AMP

RF CONNECTORS

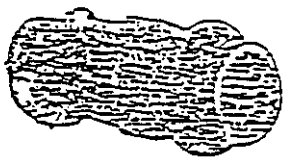
DESCRIPTION	PART NO.	MANUFACTURER
"N" TYPE		
Jack - Female - Bulkhead - For RG-55	36250	Amphenol
Plug - Male - For RG-58 & RG-55	34025	Amphenol
Jack - Female - Bulkhead - For UT-141	R161-277	Amphenol
Plug - Male - Straight - For RG-213	82-3202	Amphenol
Plug - Male - Right Angle - For RG-213	R161-163	Amphenol
"BNC" TYPE		
Plug - Male - For RG-58	31-202	Amphenol
Plug - Male - For RG-174	225395-7	Amphenol
Plug - Male - For RG-179	225395-8	Amphenol
Jack - Female - For RG-174	225398-7	Amphenol
Jack - Female - Bulkhead	31-236	Amphenol
Jack - Female - Bulkhead - Isolated Ground	UBJ27	Trompeter
"SMA" TYPE		
Plug - Male - Straight - For RG-55	142-0261-001	E.F. Johnson
Plug - Male - Right Angle - For RG-55	142-0262-001	E.F. Johnson
Plug - Male - Straight - For RG-174 & 188	142-0221-001	E.F. Johnson
Plug - Male - Right Angle - For RG-174 & 188	142-0222-001	E.F. Johnson
Plug - Male - Straight - For UT-141	142-0281-001	E.F. Johnson
Barrel Connector - Female-Female	901-302	Amphenol
"F" TYPE		
Jack - Female - Bulkhead	1220	RMS

CIRCULAR TYPE CONNECTORS

DESCRIPTION	PART NO.	MANUFACTURER
Receptacle - 4 Position - Sockets	206060-1	AMP
Receptacle Flange Mt. - 15 Position - Sockets	206705-1	AMP
Receptacle - 37 Position - Sockets	206150-1	AMP
Receptacle - Reverse Sex - 37 Pos - Sockets	206306-2	AMP
Plug - Reverse Sex - 37 Position - Pins	206305-1	AMP
Plug - 37 Position - Pins	206151-1	AMP
Plug - 15 Position - Pins	206708-1	AMP
Plug - 4 Position - Pins	206061-1	AMP
Pins - Solder Type	66180-1	AMP
Sockets - Solder Type	66181-1	AMP
Insertion/Extraction Tool	305183-R	AMP
Rear Cover - Strain Relief - 37 Position	206138-1	AMP
Rear Cover - Strain Relief - 4 Position	206062-1	AMP
Strain Relief - 15 Position	206966-1	AMP

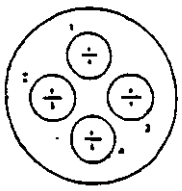
AMP

Plug

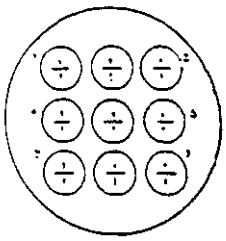


Receptacle

4 Pos.

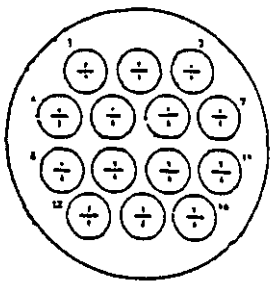


9 Pos.

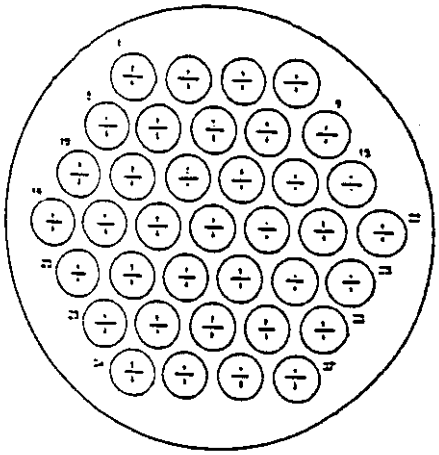


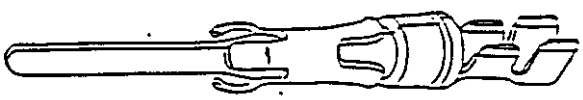
Note: Contact arrangements shown are of pin mating face (plug or receptacle). Socket mating face is mirror image.

14 Pos.

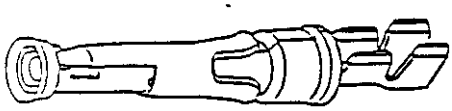


37 Pos.





Pin

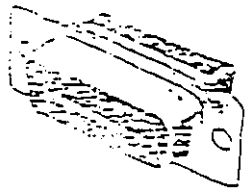


Socket

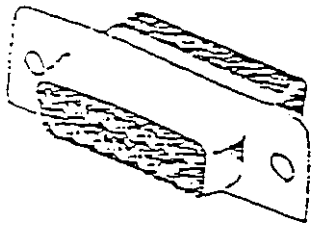
"D" TYPE CONNECTORS (1053-2020)

DESCRIPTION	PART NO.	MANUFACTURER
Receptacle - 9 Position	205203-1	AMP
Receptacle - 15 Position	205205-1	AMP
Receptacle - 25 Position	205207-1	AMP
Receptacle - 37 Position	205209-1	AMP
Sockets - Solder Type	66569-1	AMP
Plug - 9 Position	205204-1	AMP
Plug - 15 Position	205208-1	AMP
Plug - 25 Position	205210-1	AMP
Plug - 37 Position	205210-1	AMP
Pins - Solder Type	66570-3	AMP
Insertion/Extraction Tool (Crimp Type)	91067-3	AMP
Insertion/Extraction Tool (Solder Type)	91067-2	AMP
Strain Relief - 9 Position	207467-1	AMP
Strain Relief - 15 Position	207470-1	AMP
Strain Relief - 25 Position	207345-1	AMP
Strain Relief - 37 Position	207473-1	AMP
Screw and Retainer Hardware	205980-1	AMP
Standoffs and Mounting Hardware	205817-1	AMP

Plug

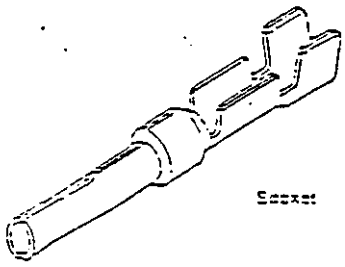


Receptacle



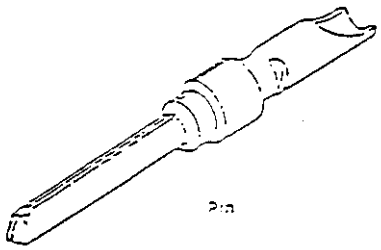
Crimp Type Contacts, Snap-In

Pin

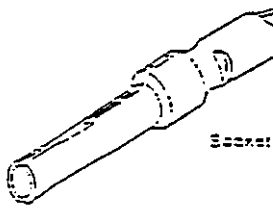


Socket

Solder Cup Contacts, Snap-In

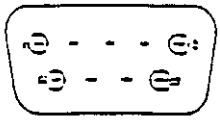


Pin

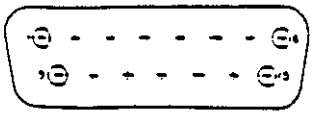


Socket

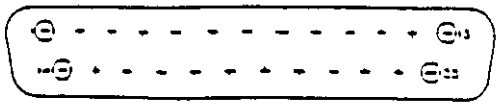
Insert Arrangements



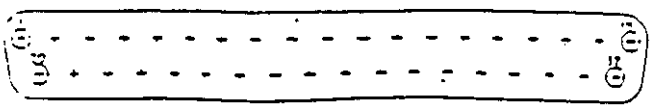
9 Position
(Shell Size 1)



15 Position
(Shell Size 2)



25 Position
(Shell Size 3)



37 Position
(Shell Size 4)

Note: Contact arrangements shown are as on mating face (plug or receptacle). Socket mating face is mirror image.

MATERIAL RETURN PROCEDURE

To insure the efficient handling of equipment or components that have been returned for repair, ITS requests that each returned item be accompanied by a Material Return Authorization Number (MRA#).

An MRA# can be obtained from any ITS Field Service Engineer by calling the ITS Service Company at 412-941-1500. This procedure applies to all items sent to the Field Service Department regardless of whether the item was originally manufactured by ITS.

TO PREVENT DAMAGE TO THE PRODUCT DURING SHIPPING, ITS WILL SUPPLY A SHIPPING CONTAINER TO THE CUSTOMER AT NO COST.

When equipment is sent to the field on loan, an MRA# is included with the unit. All shipping material should be retained for returning the unit to ITS. The MRA# is intended to be used for the return of the unit to ITS. Replacement assemblies are also sent with an MRA# to allow the proper routing of the exchanged hardware. Failure to close out this type of MRA will normally result in invoicing for the value of the loaner item or the exchange assembly.

When shipping an item to ITS, please include the MRA# on the packing list and on the ITS provided shipping container. The packing slip should also include the contact information and a brief description of why the unit is being returned.

Please forward all MRA items to:

ITS CORPORATION
375 VALLEYBROOK ROAD
McMURRAY, PA. 15317 USA

For further information concerning this procedure, call ITS Service Company at 412-941-1500 or FAX 412-941-4603.

LIMITED WARRANTY

TWO YEAR

Seller warrants each new product manufactured and sold by Seller against defects in material and workmanship under normal use and service, for a period of two (2) years from the date of shipment from Seller's plant, when operated in accordance with Seller's operating instructions. This warranty shall not apply to tubes, fuses, batteries, or bulbs.

Warranties are valid only when and if (a) Seller receives prompt written notice of breach within the period of warranty, (b) the defective product is properly packed and returned by the Buyer (transportation and insurance prepaid), and (c) Seller determines, in its sole judgement, that the product is defective and not subject to any misuse, neglect, improper installation, negligence, accident, or (unless authorized in writing by Seller) repair or alteration. Seller's exclusive liability for any personal and/or property damage (including direct, consequential or incidental) caused by the breach of any or all warranties, shall be limited to the following: (a) repairing or replacing (in Seller's sole discretion) any defective parts free of charge (F.O.B. Seller's plant), and/or (b) crediting (in Seller's sole discretion) all or a portion of the purchase price to the Buyer.

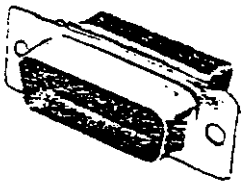
Equipment furnished by Seller, but not bearing its trade name, shall bear no warranties other than the special hours-of-use or other warranties extended by or enforceable against the manufacturer at the time of delivery to the buyer. **NO WARRANTIES, WHETHER STATUTORY, EXPRESSED OR IMPLIED, AND NO WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, OR THE LIKE, OTHER THAN AS SPECIFIED IN PATENT LIABILITY ARTICLES, AND IN THIS ARTICLE, SHALL APPLY TO THE EQUIPMENT FURNISHED HEREUNDER.**

ITS CORPORATION • 102 RAHWAY ROAD, McMURRAY, PA 15317 USA • 412-941-1500 • FAX 412-941-9421

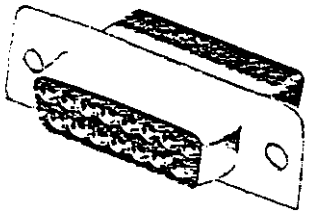
"D" Type Metal-Shell Connectors
(for Snap-In Contacts)

AMP

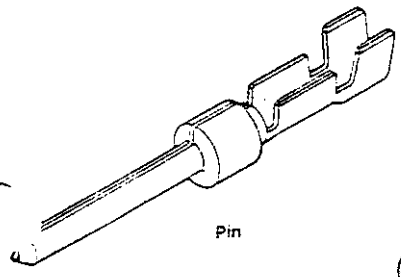
Plug

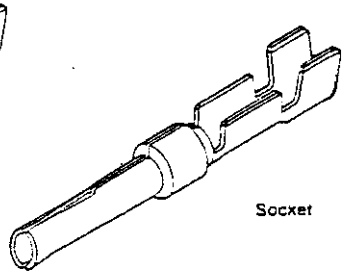


Receptacle

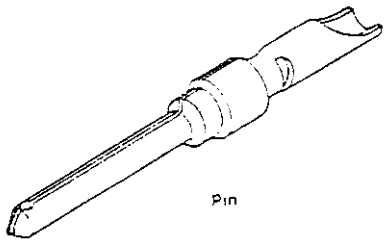


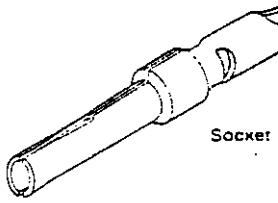
Crimp Type Contacts,
Snap-In



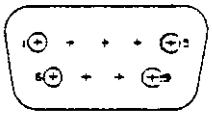


Solder Cup Contacts,
Snap-In

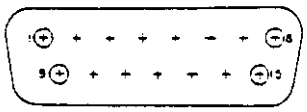




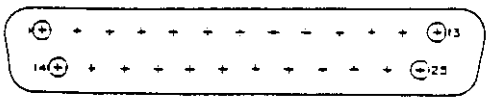
Insert Arrangements



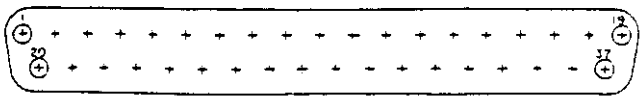
9 Position
(Shell Size 1)



15 Position
(Shell Size 2)



25 Position
(Shell Size 3)



37 Position
(Shell Size 4)

Note: Contact arrangements shown are of pin mating face (plug or receptacle). Socket mating face is mirror image.

REPLACEMENT PARTS LIST

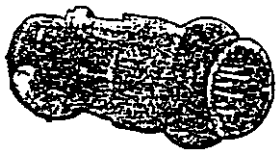
"D" TYPE CONNECTORS (1058-2020)

DESCRIPTION	PART NO.	MANUFACTURER
Receptacle - 9 Position	205203-1	AMP
Receptacle - 15 Position	205205-1	AMP
Receptacle - 25 Position	205207-1	AMP
Receptacle - 37 Position	205209-1	AMP
Sockets - Solder Type	66569-1	AMP
Plug - 9 Position	205204-1	AMP
Plug - 15 Position	205208-1	AMP
Plug - 25 Position	205210-1	AMP
Plug - 37 Position	205210-1	AMP
Pins - Solder Type	66570-3	AMP
Insertion/Extraction Tool (Crimp Type)	91067-3	AMP
Insertion/Extraction Tool (Solder Type)	91067-2	AMP
Strain Relief - 9 Position	207467-1	AMP
Strain Relief - 15 Position	207470-1	AMP
Strain Relief - 25 Position	207345-1	AMP
Strain Relief - 37 Position	207473-1	AMP
Screw and Retainer Hardware	205980-1	AMP
Standoffs and Mounting Hardware	205817-1	AMP

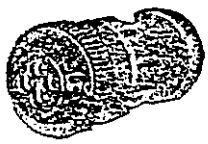
Circular Connectors

AMP

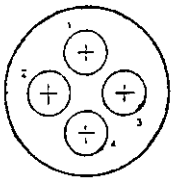
Plug



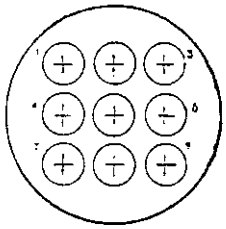
Receptacle



4 Pos.

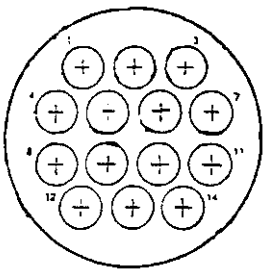


9 Pos.

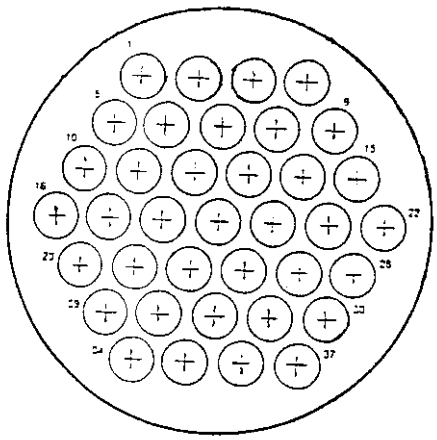


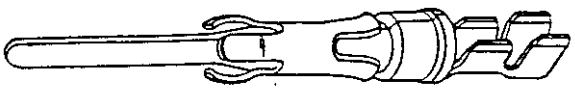
Note: Contact arrangements shown are of pin mating face (plug or receptacle)
Socket mating face is mirror image.

14 Pos.

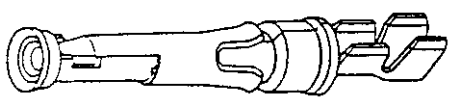


37 Pos.





Pin



Socket

REPLACEMENT PARTS LIST

CIRCULAR TYPE CONNECTORS

DESCRIPTION	PART NO.	MANUFACTURER
Receptacle - 4 Position - Sockets	206060-1	AMP
Receptacle Flange Mt. - 15 Position - Sockets	206705-1	AMP
Receptacle - 37 Position - Sockets	206150-1	AMP
Receptacle - Reverse Sex - 37 Pos - Sockets	206306-2	AMP
Plug - Reverse Sex - 37 Position - Pins	206305-1	AMP
Plug - 37 Position - Pins	206151-1	AMP
Plug - 15 Position - Pins	206708-1	AMP
Plug - 4 Position - Pins	206061-1	AMP
Pins - Solder Type	66180-1	AMP
Sockets - Solder Type	66181-1	AMP
Insertion/Extraction Tool	305183-R	AMP
Rear Cover - Strain Relief - 37 Position	206138-1	AMP
Rear Cover - Strain Relief - 4 Position	206062-1	AMP
Strain Relief - 15 Position	206966-1	AMP

REPLACEMENT PARTS LIST

RF CONNECTORS

DESCRIPTION	PART NO.	MANUFACTURER
	"N" TYPE	
Jack - Female - Bulkhead - For RG-55	36250	Amphenol
Plug - Male - For RG-58 & RG-55	34025	Amphenol
Jack - Female - Bulkhead - For UT-141	R161-277	Amphenol
Plug - Male - Straight - For RG-213	82-3202	Amphenol
Plug - Male - Right Angle - For RG-213	R161-168	Amphenol
	"BNC" TYPE	
Plug - Male - For RG-58	31-202	Amphenol
Plug - Male - For RG-174	225395-7	Amphenol
Plug - Male - For RG-179	225395-8	Amphenol
Jack - Female - For RG-174	22539S-7	Amphenol
Jack - Female - Bulkhead	31-236	Amphenol
Jack - Female - Bulkhead - Isolated Ground	UBJ27	Trompeter
	"SMA" TYPE	
Plug - Male - Straight - For RG-55	142-0261-001	E.F. Johnson
Plug - Male - Right Angle - For RG-55	142-0262-001	E.F. Johnson
Plug - Male - Straight - For RG-174 & 188	142-0221-001	E.F. Johnson
Plug - Male - Right Angle - For RG-174 & 188	142-0222-001	E.F. Johnson
Plug - Male - Straight - For UT-141	142-0281-001	E.F. Johnson
Barrel Connector - Female-Female	901-302	Amphenol
	"F" TYPE	
Jack - Female - Bulkhead	1220	RMS

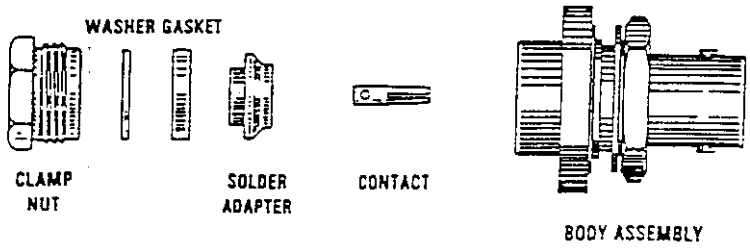
REPLACEMENT PARTS LIST

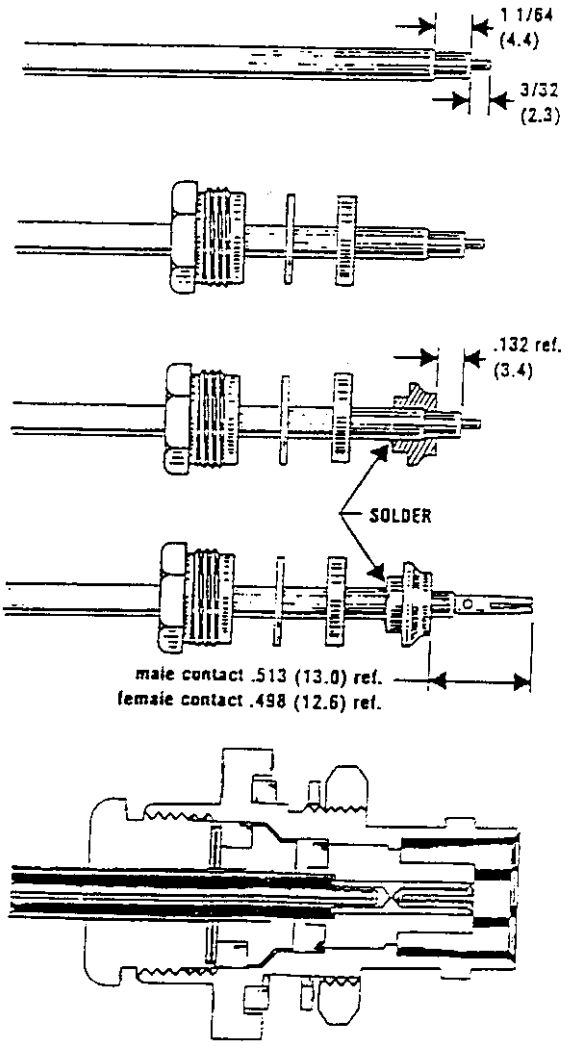
BLACK/WHITE CONTACT HOUSINGS (1058-2020)

DESCRIPTION	PART NO.	MANUFACTURER
This first group of items refers to the small, black plugs that connect to boards.		
Plug - 2 Pos. - .1" Ctrs.	87499-3	AMP
Plug - 3 Pos. - .1" Ctrs.	87499-5	AMP
Plug - 4 Pos. - .1" Ctrs.	87499-7	AMP
Plug - 5 Pos. - .1" Ctrs.	87499-9	AMP
Plug - 6 Pos. - .1" Ctrs.	1-87499-1	AMP
Plug - 7 Pos. - .1" Ctrs.	87499-1	AMP
Plug - 8 Pos. - .1" Ctrs.	1-87499-3	AMP
Plug - 9 Pos. - .1" Ctrs.	1-87499-5	AMP
Plug - 10 Pos. - .1" Ctrs.	1-87499-7	AMP
Plug - 11 Pos. - .1" Ctrs.	1-87499-9	AMP
Plug - 12 Pos. - .1" Ctrs.	2-87499-1	AMP
Female Receptacle for .1" Ctrs. Plugs	1-87309-4	AMP
Keying Plug for .1" Ctrs. Plugs	87077-2	AMP
Hand Tool	90345-1	AMP
This second group of items refers to the larger white plugs which also connect to boards.		
Plug - 4 Pos. - .156" Ctrs.	1-87025-3	AMP
Plug - 5 Pos. - .156" Ctrs.	2-87025-3	AMP
Plug - 8 Pos. - .156" Ctrs.	1-87025-6	AMP
Plug - 10 Pos. - .156" Ctrs.	1-87025-8	AMP
Plug - 12 Pos. - .156" Ctrs.	1-87025-2	AMP
Plug - 14 Pos. - .156" Ctrs.	3-87025-8	AMP
Female Receptacle for .156" Ctrs.	102104-2	AMP
Keying Plug for .156" Ctrs. Plug	87116-2	AMP
Hand Tool	90274-2	AMP

BNC ASSEMBLY INSTRUCTIONS

SOLDER-TYPE





Trim cable square, deburr and clean copper jacket 5/8" (15.9) minimum. Strip to dimensions shown.

Slide clamp nut, washer and gasket OVER cable jacket as shown.

Slide solder adapter into position over cable so that outer conductor bottoms on internal shoulder. Solder as shown. Avoid excessive heat which may deform dielectric. After assembly has cooled, verify dimension shown and trim dielectric if necessary.

Solder center contact to inner conductor. Center contact must seat square against dielectric. Again, avoid excessive heat which may deform dielectric. Verify dimension shown to assure mechanical and electrical integrity of assembly.

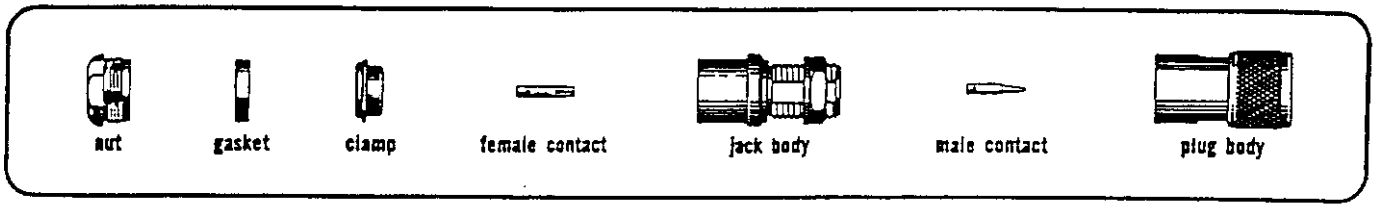
Insert cable assembly into body assembly. Move gasket and washer into position and tighten clamp nut.

N

coaxial connectors

assembly instructions

improved & UG-clamp

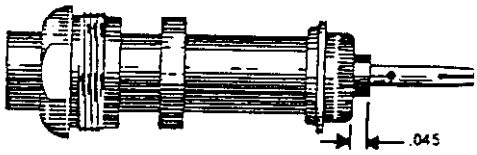


Improved		UG-Clamp		
a	b	part no.	a	b
9/32		82-4352-1	9/32	5/32
		82-4352	23/64	15/64
		82-4356-1	9/32	5/32
		82-4356	23/64	15/64
		82-4360-1	9/32	5/32
		82-4360	23/64	15/64
		82-4364	9/32	5/32
		82-4357	9/32	5/32

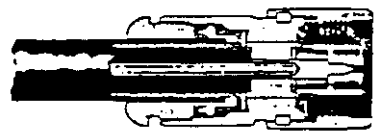
Place nut and gasket, with "V" groove toward clamp, over cable and cut off jacket to dim. a.

Comb out braid and fold out. Cut off cable dielectric to dim. b as shown.

Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.



Fold back braid wires as shown, trim to proper length and form over clamp as shown. Solder contact to center conductor.



Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut.

note: For armored cable slide cap over armor first. Push armor and cap back out of way and proceed with assembly as directed above using armor clamp in place of standard clamp nut. When assembly is complete straighten bulge in armor and trim so it can be clamped between nut and cap.

DRAWING NUMBER SYSTEM EXPLANATION

Each assembly or subassembly in the transmitter is assigned an eight digit number that consists of two groups of four numbers each. The first digit in the second group of four numbers is the only digit that changes in any one assembly. The changing digit designates which type of drawing the number refers to. An example of one number with all possibilities is given below.

XXXX-1XXX COMPLETE ASSEMBLY, SUBASSEMBLY OR BOARD

XXXX-2XXX REPLACEMENT PARTS LIST

XXXX-3XXX SCHEMATIC OR BLOCK DIAGRAM

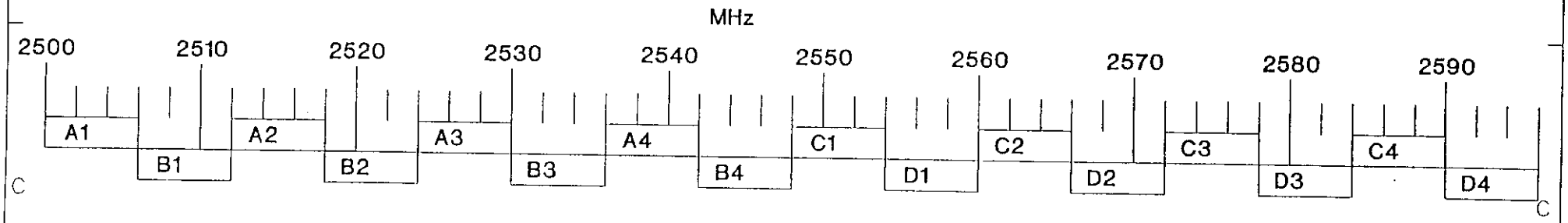
XXXX-7XXX CONTROL LOCATIONS DRAWING

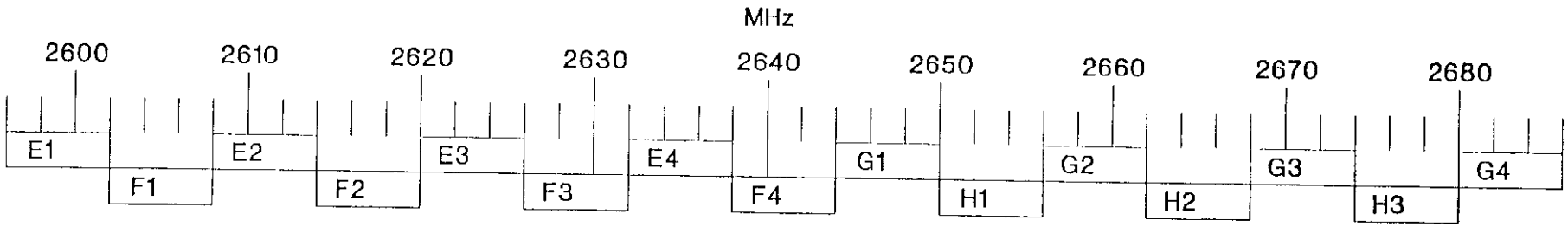
XXXX-8XXX INTERCONNECT DRAWING

ITFS/MDS/OFS CHANNELS

GROUP	CHANNEL	FREQ BAND (MHz)	VISUAL FREQ (MHz)	AURAL FREQ (MHz)	L.O. FREQ (MHz)	CRYSTAL FREQ (MHz)
A	A-1	2500-2506	2501.250	2505.750	2547.000	106.125
A	A-2	2512-2518	2513.250	2517.750	2559.000	106.625
A	A-3	2524-2530	2525.250	2529.750	2571.000	107.125
A	A-4	2536-2542	2537.250	2541.750	2583.000	107.625
B	B-1	2506-2512	2507.250	2511.750	2553.000	106.375
B	B-2	2518-2524	2519.250	2523.750	2565.000	106.875
B	B-3	2530-2536	2531.250	2535.750	2577.000	107.375
B	B-4	2542-2548	2543.250	2547.750	2589.000	107.875
C	C-1	2548-2554	2549.250	2553.750	2595.000	108.125
C	C-2	2560-2566	2561.250	2565.750	2607.000	108.625
C	C-3	2572-2578	2573.250	2577.750	2619.000	109.125
C	C-4	2584-2590	2585.250	2589.750	2631.000	109.625
D	D-1	2554-2560	2555.250	2559.750	2601.000	108.375
D	D-2	2566-2572	2567.250	2571.750	2613.000	108.875
D	D-3	2578-2584	2579.250	2583.750	2625.000	109.375
D	D-4	2590-2596	2591.250	2595.750	2637.000	109.875
E	E-1	2596-2602	2597.250	2601.750	2643.000	110.125
E	E-2	2608-2614	2609.250	2613.750	2655.000	110.625
E	E-3	2620-2626	2621.250	2625.750	2667.000	111.125
E	E-4	2632-2638	2633.250	2637.750	2679.000	111.625
F	F-1	2602-2608	2603.250	2607.750	2649.000	110.375
F	F-2	2614-2620	2615.250	2619.750	2661.000	110.875
F	F-3	2626-2632	2627.250	2631.750	2673.000	111.375
F	F-4	2638-2644	2639.250	2643.750	2685.000	111.875
G	G-1	2644-2650	2645.250	2649.750	2691.000	112.125
G	G-2	2656-2662	2657.250	2661.750	2703.000	112.625
G	G-3	2668-2674	2669.250	2673.750	2715.000	113.125
G	G-4	2680-2686	2681.250	2685.750	2727.000	113.625
H	H-1	2650-2656	2651.250	2655.750	2697.000	112.375
H	H-2	2662-2668	2663.250	2667.750	2709.000	112.875
H	H-3	2674-2680	2675.250	2679.750	2721.000	113.375
H RESPONSE	H-4	2686-2692				

ITFS/WIRELESS CABLE FREQUENCY ALLOCATIONS FOR USA & CANADA





ITS CORPORATION	REV	ECN	DATE	APV

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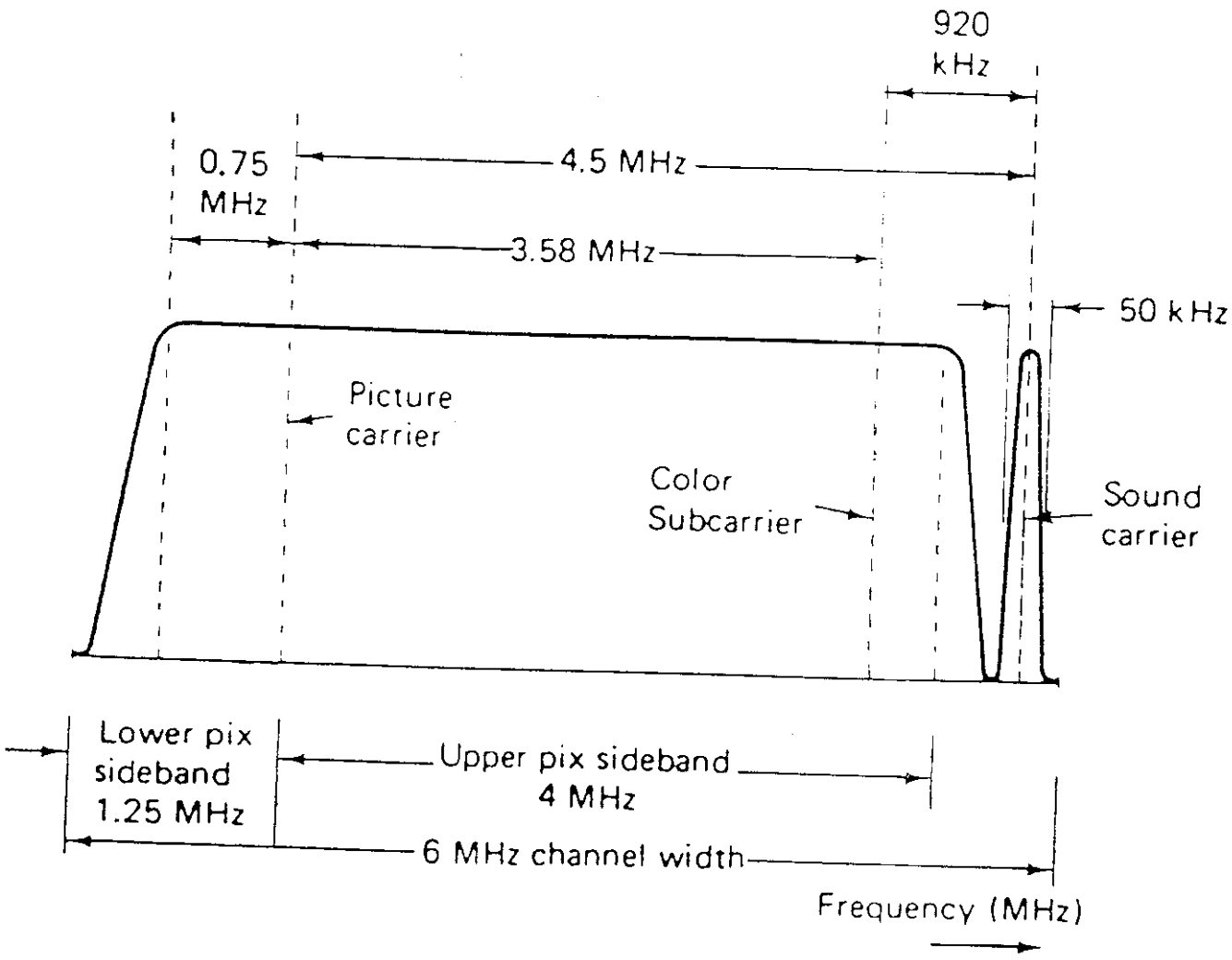
MATERIAL

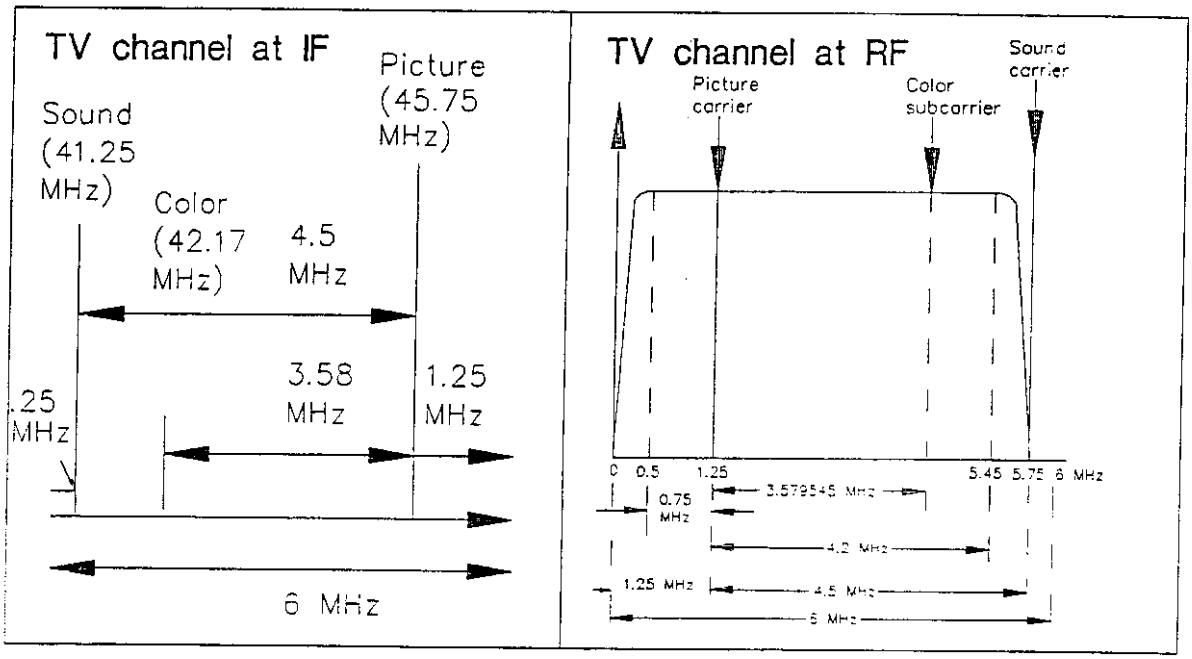
FINISH

TITLE *INSTRUCTION BOOK DWG – ITFS/WIRELESS CABLE FREQUENCY ALLOCATIONS*

			DWG. NO.	REV
DWN	JCM	5-10-93	1193-7038	PC
CHK	JCM	5-10-93		

SIDEBAND SPECTRUM CHART

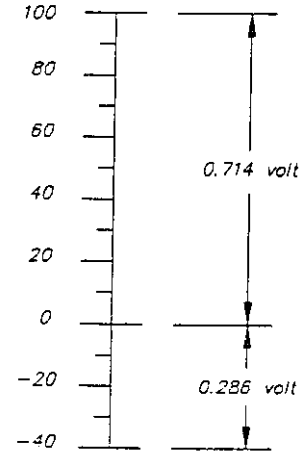




Video Levels

Waveform monitor IRE units and oscilloscope peak-to-peak voltages

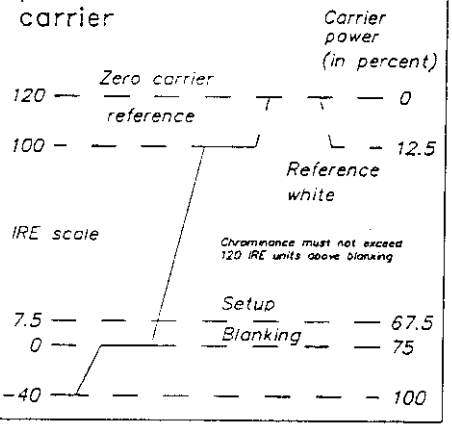
Video parameter	Waveform monitor IRE units	Oscilloscope peak-to-peak voltage
Reference	*1*	*0.00714 volt*
Horizontal sync amplitude	*40*	*0.0286 volt*
Color burst amplitude	*40*	*0.0286 volt*
Setup	*7.5*	*0.054 volt*
Video (blanking-to-peak white)	*100*	*0.714 volt*
Total video signal amplitude	*140*	*1 volt*



IRE scale units relative to 1 volt peak-to-peak video amplitude

1 IRE unit = 0.0071429 volt

Relative levels of sync, picture and zero carrier



AMPLITUDE CONVERSIONS

The Spectrum Analyzer reads signal levels in dBm. The following equations allow conversion from dBm to dBmV or dBμV in a 50 Ω system.

CONVERSION EQUATIONS

dBm	+ 107dBμV	=	dBμV
dBm	+ 47dBmV	=	dBmV
dBmV	+ 60dB	=	dBμV

If it is desired to convert from logarithmic units to linear units, then the equations given below will be useful. Keep in mind that the logarithmic levels are all referenced to linear units.

i.e., 0 dBm referenced to 1 mw
0 dBmV referenced to 1 mV
0 dBμV referenced to 1 μV

Therefore, to calculate a linear level, simply take the antilog of the logarithmic level.

dBm to P (mW)

$$dBm = 10 \log \frac{P}{1mW}, \quad P = \log^{-1} \frac{dBm}{10}$$

dBmV to V (mV)

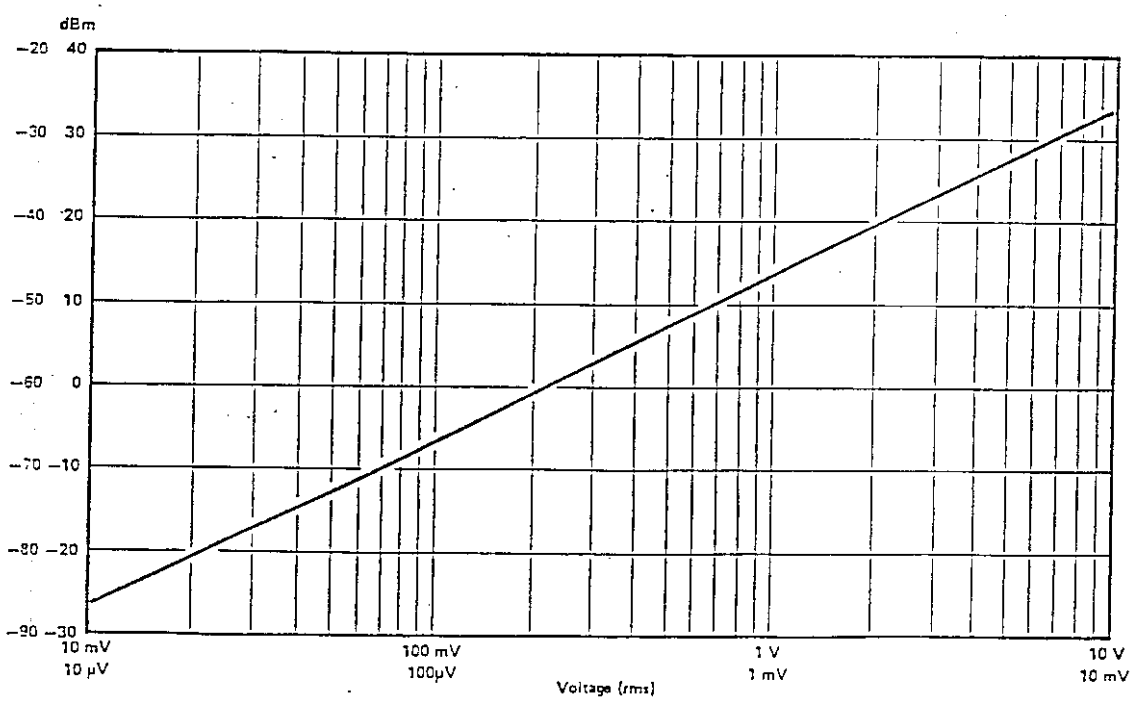
$$dBmV = 20 \log \frac{V}{1mV}, \quad V = \log^{-1} \frac{dBmV}{20}$$

dBμV to V (μV)

$$dB\mu V = 20 \log \frac{V}{1\mu V}, \quad V = \log^{-1} \frac{dB\mu V}{20}$$

Figure 46 below converts from dBm to voltage in a 50 Ω system.

Conversion from dBm to volts can be made whether the AMPLITUDE SCALE is in LOG/DIV or LINear. To read voltage on the Analyzer , position the signal on the REFERENCE LEVEL line of the CRT. Read the REF LEVEL in dBm and find its equivalent voltage from the Conversion Chart.



Conversion chart—converts from dBm to voltage in 50 Ω

dBm, dBw, dBmV, dBμV and VOLTAGE EXPRESSED IN WATTS (50 OHM SYSTEM)

WATTS	PREFIX	dBm	dBw	dBmV	dBμV	VOLTAGE
1,000,000,000,000	1 Terawatt	+150	+120			
100,000,000,000	100 Gigawatts	+140	+110			
10,000,000,000	10 Gigawatts	+130	+100			
1,000,000,000	1 Gigawatt	+120	+90			
100,000,000	100 Megawatts	+110	+80			
10,000,000	10 Megawatts	+100	+70			
1,000,000	1 Megawatt	+90	+60			
100,000	100 Kilowatts	+80	+50			
10,000	10 Kilowatts	+70	+40			
1.000	1 Kilowatt	+60	+30			
100	1 Hectrowatt	+50	+20			
50		+47	+17			
20		+43	+13			
10	1 Decawatt	+40	+10			
1	1 Watt	+30	0	+77	+137	7.07V
0.1	1 Deciwatt	+20	-10	+67	+127	2.24V
0.01	1 Centiwatt	+10	-20	+57	+117	0.707V
0.001	1 Milliwatt	0	-30	+47	+107	224mV
0.000,1	100 Microwatts	-10	-40			
0.000,01	10 Microwatts	-20	-50			
0.000,001	1 Microwatt	-30	-60			
0.000,000,1	100 Nanowatts	-40	-70			
0.000,000,01	10 Nanowatts	-50	-80			
0.000,000,001	1 Nanowatt	-60	-90			
0.000,000,000,1	100 Picowatts	-70	-100			
0.000,000,000,01	10 Picowatts	-80	-110			
0.000,000,000,001	1 Picowatt	-90	-120			

TEMPERATURE

32 + [(9/5) °C] = °F		(5/9) (°F - 32) = °C	
°C	°F	°C	°F
-50	-58	60	140
-40	-40	70	158
-30	-22	80	176
-20	-4	90	194
-10	14	100	212
0	32	110	230
10	50	120	248
20	68	130	266
30	86	140	284
40	104	150	302
50	122	160	320

Conversion Table: Fractions, Decimals, and Millimeters*

Inches		mm	Inches		mm	Inches		mm	Inches		mm
fractions	decimals		fractions	decimals		fractions	decimals		fractions	decimals	
–	.0004	.01	25/32	.781	19.844	–	2.165	55.	3-11/16	3.6875	93.663
–	.004	.10	–	.7874	20.	2-3/16	2.1875	55.563	–	3.7008	94.
–	.01	.25	51/64	.797	20.241	–	2.2047	56.	3-23/32	3.719	94.456
1/64	.0156	.397	13/16	.8125	20.638	2-7/32	2.219	56.356	–	3.7401	95.
–	.0197	.50	–	.8268	21.	–	2.244	57.	3-3/4	3.750	95.250
–	.0295	.75	53/64	.828	21.034	2-1/4	2.250	57.150	–	3.7795	96.
1/32	.03125	.794	27/32	.844	21.431	2-9/32	2.281	57.944	3-25/32	3.781	96.044
–	.0394	1.	55/64	.859	21.828	–	2.2835	58.	3-13/16	3.8125	96.838
3/64	.0469	1.191	–	.8661	22.	2-5/16	2.312	58.738	–	3.8189	97.
–	.059	1.5	7/8	.875	22.225	–	2.3228	59.	3-27/32	3.844	97.631
1/16	.062	1.588	57/64	.8906	22.622	2-11/32	2.344	59.531	–	3.8583	98.
5/64	.0781	1.984	–	.9055	23.	–	2.3622	60.	3-7/8	3.875	98.425
–	.0787	2.	29/32	.9062	23.019	2-3/8	2.375	60.325	–	3.8976	99.
3/32	.094	2.381	59/64	.922	23.416	–	2.4016	61.	3-29/32	3.9062	99.219
–	.0984	2.5	15/16	.9375	23.813	2-13/32	2.406	61.119	–	3.9370	100.
7/64	.109	2.778	–	.9449	24.	2-7/16	2.438	61.913	3-15/16	3.9375	100.013
–	.1181	3.	61/64	.953	24.209	–	2.4409	62.	3-31/32	3.969	100.806
1/8	.125	3.175	31/32	.969	24.606	2-15/32	2.469	62.706	–	3.9764	101.
–	.1378	3.5	–	.9843	25.	–	2.4803	63.	4	4.000	101.600
9/64	.141	3.572	63/64	.9844	25.003	2-1/2	2.500	63.500	4-1/16	4.062	103.188
5/32	.156	3.969	1	1.000	25.400	–	2.5197	64.	4-1/8	4.125	104.775
–	.1575	4.	–	1.0236	26.	2-17/32	2.531	64.294	–	4.1338	105.
11/64	.172	4.366	1-1/32	1.0312	26.194	–	2.559	65.	4-3/16	4.1875	106.363
–	.177	4.5	1-1/16	1.062	26.988	2-9/16	2.562	65.088	4-1/4	4.250	107.950
3/16	.1875	4.763	–	1.063	27.	2-19/32	2.594	65.881	4-5/16	4.312	109.538
–	.1969	5.	1-3/32	1.094	27.781	–	2.5984	66.	–	4.3307	110.
13/64	.203	5.159	–	1.1024	28.	2-5/8	2.625	66.675	4-3/8	4.375	111.125
–	.2165	5.5	1-1/8	1.125	28.575	–	2.638	67.	4-7/16	4.438	112.713
7/32	.219	5.556	–	1.1417	29.	2-21/32	2.656	67.469	4-1/2	4.500	114.300
15/64	.234	5.953	1-5/32	1.156	29.369	–	2.6772	68.	–	4.5275	115.
–	.2362	6.	–	1.1811	30.	2-11/16	2.6875	68.263	4-9/16	4.562	115.888
1/4	.250	6.350	1-3/16	1.1875	30.163	–	2.7165	69.	4-5/8	4.625	117.475
–	.2559	6.5	1-7/32	1.219	30.956	2-23/32	2.719	69.056	4-11/16	4.6875	119.063
17/64	.2656	6.747	–	1.2205	31.	2-3/4	2.750	69.850	–	4.7244	120.
–	.2756	7.	1-1/4	1.250	31.750	–	2.7559	70.	4-3/4	4.750	120.650
9/32	.281	7.144	–	1.2598	32.	2-25/32	2.781	70.6439	4-13/16	4.8125	122.238
–	.2953	7.5	1-9/32	1.281	32.544	–	2.7953	71.	4-7/8	4.875	123.825
19/64	.297	7.541	–	1.2992	33.	2-13/16	2.8125	71.4376	–	4.9212	125.
5/16	.312	7.938	1-5/16	1.312	33.338	–	2.8346	72.	4-15/16	4.9375	125.413
–	.315	8.	–	1.3386	34.	2-27/32	2.844	72.2314	5	5.000	127.000
21/64	.328	8.334	1-11/32	1.344	34.131	–	2.8740	73.	–	5.1181	130.
–	.335	8.5	1-3/8	1.375	34.925	2-7/8	2.875	73.025	5-1/4	5.250	133.350
11/32	.344	8.731	–	1.3779	35.	2-29/32	2.9062	73.819	5-1/2	5.500	139.700
–	.3543	9.	1-13/32	1.406	35.719	–	2.9134	74.	–	5.5118	140.
23/64	.359	9.128	–	1.4173	36.	2-15/16	2.9375	74.613	5-3/4	5.750	146.050
–	.374	9.5	1-7/16	1.438	36.513	–	2.9527	75.	–	5.9055	150.
3/8	.375	9.525	–	1.4567	37.	2-31/32	2.969	75.406	6	6.000	152.400
25/64	.391	9.922	1-15/32	1.469	37.306	–	2.9921	76.	6-1/4	6.250	158.750
–	.3937	10.	–	1.4961	38.	3	3.000	76.200	–	6.2992	160.
13/32	.406	10.319	1-1/2	1.500	38.100	3-1/32	3.0312	76.994	6-1/2	6.500	165.100
–	.413	10.5	1-17/32	1.531	38.894	–	3.0315	77.	–	6.6929	170.
27/64	.422	10.716	–	1.5354	39.	3-1/16	3.062	77.788	6-3/4	6.750	171.450
–	.4331	11.	1-9/16	1.562	39.688	–	3.0709	78.	7	7.000	177.800
7/16	.438	11.113	–	1.5748	40.	3-3/32	3.094	78.581	–	7.0866	180.
29/64	.453	11.509	1-19/32	1.594	40.481	–	3.1102	79.	–	7.4803	190.
15/32	.469	11.906	–	1.6142	41.	3-1/8	3.125	79.375	7-1/2	7.500	190.500
–	.4724	12.	1-5/8	1.625	41.275	–	3.1496	80.	–	7.8740	200.
31/64	.484	12.303	–	1.6535	42.	3-5/32	3.156	80.169	8	8.000	203.200
–	.492	12.5	1-21/32	1.6562	42.069	3-3/16	3.1875	80.963	–	8.2677	210.
1/2	.500	12.700	1-11/16	1.6875	42.863	–	3.1890	81.	8-1/2	8.500	215.900
–	.5118	13.	–	1.6929	43.	3-7/32	3.219	81.756	–	8.6614	220.
33/64	.5156	13.097	1-23/32	1.719	43.656	–	3.2283	82.	9	9.000	228.600
17/32	.531	13.494	–	1.7323	44.	3-1/4	3.250	82.550	–	9.0551	230.
35/64	.547	13.891	1-3/4	1.750	44.450	–	3.2677	83.	–	9.4488	240.
–	.5512	14.	–	1.7717	45.	3-9/32	3.281	83.344	9-1/2	9.500	241.300
9/16	.563	14.288	1-25/32	1.781	45.244	–	3.3071	84.	–	9.8425	250.
–	.571	14.5	–	1.8110	46.	3-5/16	3.312	84.1377	10	10.000	254.001
37/64	.578	14.684	1-13/16	1.8125	46.038	3-11/32	3.344	84.9314	–	10.2362	260.
–	.5906	15.	1-27/32	1.844	46.831	–	3.3464	85.	–	10.6299	270.
19/32	.594	15.081	–	1.8504	47.	3-3/8	3.375	85.725	11	11.000	279.401
39/64	.609	15.478	1-7/8	1.875	47.625	–	3.3858	86.	–	11.0236	280.
5/8	.625	15.875	–	1.8898	48.	3-13/32	3.406	86.519	–	11.4173	290.
–	.5299	16.	1-29/32	1.9062	48.419	–	3.4252	87.	–	11.8110	300.
41/64	.6406	16.272	–	1.9291	49.	3-7/16	3.438	87.313	12	12.000	304.801
–	.6496	16.5	1-15/16	1.9375	49.213	–	3.4646	88.	13	13.000	330.201
21/32	.656	16.669	–	1.9685	50.	3-15/32	3.469	88.106	–	13.7795	350.
–	.6693	17.	1-31/32	1.969	50.006	3-1/2	3.500	88.900	14	14.000	355.601
43/64	.672	17.066	2	2.000	50.800	–	3.5039	89.	15	15.000	381.001
11/16	.6875	17.463	–	2.0079	51.	3-17/32	3.531	89.694	–	15.7480	400.
45/64	.703	17.859	2-1/32	2.03125	51.594	–	3.5433	90.	16	16.000	406.401
–	.7087	18.	–	2.0472	52.	3-9/16	3.562	90.4877	17	17.000	431.801
23/32	.719	18.256	2-1/16	2.062	52.388	–	3.5827	91.	–	17.7165	450.
–	.7283	18.5	–	2.0866	53.	3-19/32	3.594	91.281	18	18.000	457.201
47/64	.734	18.653	2-3/32	2.094	53.181	–	3.622	92.	19	19.000	482.601
–	.7480	19.	2-1/8	2.125	53.975	3-5/8	3.625	92.075	–	19.6850	500.
3/4	.750	19.050	–	2.126	54.	3-21/32	3.656	92.869	20	20.000	508.001
49/64	.7656	19.447	2-5/32	2.156	54.769	–	3.6614	93.			

*Adapted from "TRUARC Technical Manual of Retaining Rings and Assembly Tools."

dB TABLE

dB	VOLTAGE OR CURRENT RATIO	POWER RATIO	dB	VOLTAGE OR CURRENT RATIO	POWER RATIO
0.0	1.000	1.000	26.	19.95	398.1
0.1	1.012	1.023	27.	22.39	501.2
0.2	1.023	1.047	28.	25.12	631.0
0.3	1.035	1.072	29.	28.18	794.3
0.4	1.047	1.096	30.	31.62	1000.0
0.5	1.059	1.122	31.	35.48	1259.0
0.6	1.072	1.148	32.	39.81	1585.0
0.8	1.096	1.202	33.	44.67	1995.0
1.0	1.122	1.259	34.	50.12	2512.0
1.5	1.189	1.413	35.	56.23	3162.0
2.0	1.259	1.585	36.	63.10	3981.0
2.5	1.334	1.778	37.	70.79	5012.0
3.0	1.413	1.995	38.	79.43	6310.0
4.0	1.585	2.512	39.	89.13	7943.0
5.0	1.778	3.162	40.	100.00	10000.
6.0	1.995	3.981	41.	112.20	12590.
7.0	2.239	5.012	42.	125.90	15850.
8.0	2.512	6.310	43.	141.30	19950.
9.0	2.818	7.943	44.	158.50	25120.
10.0	3.162	10.000	45.	177.80	31620.
11.0	3.548	12.590	46.	199.50	39810.
12.	3.981	15.850	47.	223.90	50120.
13.	4.467	19.950	48.	251.20	63100.
14.	5.012	25.120	49.	281.80	79430.
15.	5.623	31.620	50.	316.20	100000.0
16.	6.310	39.810	51.	354.80	125900.0
17.	7.079	50.120	52.	398.10	158500.0
18.	7.943	63.100	53.	446.70	199500.0
19.	8.913	79.43	54.	501.20	251200.0
20.	10.000	100.00	55.	562.30	316200.0
21.	11.220	125.90	56.	631.00	398100.0
22.	12.590	158.50	57.	707.90	501200.0
23.	14.130	199.50	58.	794.30	631000.0
24.	15.850	251.20	59.	891.30	794300.0
25.	17.780	316.20	60.	1000.00	1000000.

Power Conversion Chart

Frequently when working with several types of equipment it is necessary to convert from one form of power measurement to another. The accompanying chart will make these conversions easier.

Power dbm	Power Watts	Microvolts 50 Ohms	Microvolts 75 Ohms	Power dbmv
-108.75	13.33 fw	0.82	1.00	-60
-107.75	16.78 fw	0.92	1.12	-59
-106.75	21.13 fw	1.03	1.26	-58
-105.75	26.60 fw	1.15	1.41	-57
-104.75	33.49 fw	1.29	1.58	-56
-103.75	42.16 fw	1.45	1.78	-55
-102.75	53.08 fw	1.63	2.00	-54
-101.75	66.82 fw	1.83	2.24	-53
-100.75	84.12 fw	2.05	2.51	-52
-99.75	105.90 fw	2.30	2.82	-51
-98.75	133.32 fw	2.58	3.16	-50
-97.75	167.84 fw	2.90	3.55	-49
-96.75	211.30 fw	3.25	3.98	-48
-95.75	266.01 fw	3.65	4.47	-47
-94.75	334.89 fw	4.09	5.01	-46
-93.75	421.60 fw	4.59	5.62	-45
-92.75	530.76 fw	5.15	6.31	-44
-91.75	668.19 fw	5.78	7.08	-43
-90.75	841.20 fw	6.49	7.94	-42
-89.75	1.06 pw	7.28	8.91	-41
-88.75	1.33 pw	8.16	10.00	-40
-87.75	1.68 pw	9.16	11.22	-39
-86.75	2.11 pw	10.28	12.59	-38
-85.75	2.66 pw	11.53	14.13	-37
-84.75	3.35 pw	12.94	15.85	-36
-83.75	4.22 pw	14.52	17.78	-35
-82.75	5.31 pw	16.29	19.95	-34
-81.75	6.68 pw	18.28	22.39	-33
-80.75	8.41 pw	20.51	25.12	-32
-79.75	10.59 pw	23.01	28.18	-31
-78.75	13.33 pw	25.82	31.62	-30
-77.75	16.78 pw	28.97	35.48	-29
-76.75	21.13 pw	32.50	39.81	-28
-75.75	26.60 pw	36.47	44.67	-27
-74.75	33.49 pw	40.92	50.12	-26
-73.75	42.16 pw	45.91	56.23	-25
-72.75	53.08 pw	51.52	63.10	-24
-71.75	66.82 pw	57.80	70.79	-23
-70.75	84.12 pw	64.85	79.43	-22
-69.75	105.90 pw	72.77	89.13	-21
-68.75	133.32 pw	81.65	100.00	-20
-67.75	167.84 pw	91.61	112.20	-19
-66.75	211.30 pw	102.79	125.89	-18
-65.75	266.01 pw	115.33	141.25	-17
-64.75	334.89 pw	129.40	158.49	-16
-63.75	421.60 pw	145.19	177.83	-15
-62.75	530.76 pw	162.91	199.53	-14
-61.75	668.19 pw	182.78	223.87	-13
-60.75	841.20 pw	205.09	251.19	-12
-59.75	1.06 nw	230.11	281.84	-11
-58.75	1.33 nw	258.19	316.23	-10
-57.75	1.68 nw	289.69	354.81	-9
-56.75	2.11 nw	325.04	398.11	-8
-55.75	2.66 nw	364.70	446.68	-7
-54.75	3.35 nw	409.20	501.19	-6
-53.75	4.22 nw	459.13	562.34	-5
-52.75	5.31 nw	515.15	630.96	-4
-51.75	6.68 nw	578.01	707.95	-3
-50.75	8.41 nw	648.54	794.33	-2
-49.75	10.59 nw	727.67	891.25	-1
-48.75	13.33 nw	816.46	1000	0

Power dbm	Power Watts	Microvolts 50 Ohms	Microvolts 75 Ohms	Power dbmv
-48.75	13.33 nw	816.46	1000	0
-47.75	16.78 nw	916.38	1122	1
-46.75	21.13 nw	1029	1259	2
-45.75	26.60 nw	1153	1413	3
-44.75	33.49 nw	1294	1585	4
-43.75	42.16 nw	1452	1778	5
-42.75	53.08 nw	1629	1995	6
-41.75	66.82 nw	1828	2239	7
-40.75	84.12 nw	2051	2512	8
-39.75	105.90 nw	2301	2818	9
-38.75	133.32 nw	2582	3162	10
-37.75	167.84 nw	2897	3548	11
-36.75	211.30 nw	3250	3981	12
-35.75	266.01 nw	3647	4467	13
-34.75	334.89 nw	4092	5012	14
-33.75	421.60 nw	4591	5623	15
-32.75	530.76 nw	5152	6310	16
-31.75	668.19 nw	5780	7079	17
-30.75	841.20 nw	6485	7943	18
-29.75	1.06 uw	7277	8913	19
-28.75	1.33 uw	8166	10000	20
-27.75	1.68 uw	9161	11220	21
-26.75	2.11 uw	10278	12589	22
-25.75	2.66 uw	11533	14125	23
-24.75	3.35 uw	12940	15849	24
-23.75	4.22 uw	14519	17783	25
-22.75	5.31 uw	16291	19953	26
-21.75	6.68 uw	18278	22387	27
-20.75	8.41 uw	20509	25119	28
-19.75	10.59 uw	23011	28184	29
-18.75	13.33 uw	25819	31622	30
-17.75	16.78 uw	28969	35481	31
-16.75	21.13 uw	32504	39811	32
-15.75	26.60 uw	36470	44668	33
-14.75	33.49 uw	40920	50119	34
-13.75	42.16 uw	45913	56234	35
-12.75	53.08 uw	51515	63096	36
-11.75	66.82 uw	57801	70795	37
-10.75	84.12 uw	64854	79433	38
-9.75	105.90 uw	72767	89125	39
-8.75	133.32 uw	81646	100000	40
-7.75	167.84 uw	91608	112202	41
-6.75	211.30 uw	102786	125893	42
-5.75	266.01 uw	115328	141254	43
-4.75	334.89 uw	129400	158489	44
-3.75	421.60 uw	145189	177828	45
-2.75	530.76 uw	162905	199526	46
-1.75	668.19 uw	182783	223872	47
-0.75	841.20 uw	205086	251189	48
0.00	1.00 mw	223607	273873	48.75
0.25	1.06 mw	230110	281838	49
1.25	1.33 mw	258187	316228	50
2.25	1.68 mw	289691	354813	51
3.25	2.11 mw	325039	398107	52
4.25	2.66 mw	364699	446684	53
5.25	3.35 mw	409199	501187	54
6.25	4.22 mw	459129	562341	55
7.25	5.31 mw	515152	630957	56
8.25	6.68 mw	578010	707946	57
9.25	8.41 mw	648537	794328	58
10.25	10.59 mw	727671	891251	59
11.25	13.33 mw	816460	1000000	60

0 dbm = 1 mw across 50 Ohms
0 dbmv = 1000 uv across 75 Ohms
1 femtowatt (fw) = 1×10^{-15} Watt
1 picowatt (pw) = 1×10^{-12} Watt

1 nanowatt (nw) = 1×10^{-9} Watt
1 microwatt (uw) = 1×10^{-6} Watt
1 milliwatt (mw) = 1×10^{-3} Watt

Voltage and Power Ratios to Decibels

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of −20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: 2,000:1 to dB, express 2,000 as 2×10^3; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:2 is approximately 30 dB + 3 dB −33 dB. In the lower right-hand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	Power Ratio	−dB+	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	dB	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	−dB+	Voltage Ratio	Power Ratio
1.000	1.000	0	1.000	1.000	.447	.200	7.0	2.239	5.012	.200	.0398	14.0	5.012	25.12
.989	.977	0.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	0.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	0.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	0.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	0.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	0.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	0.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	0.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	0.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	.794	1.0	1.122	1.259	.398	.159	8.0	2.512	6.310	.178	.0316	15.0	5.623	31.62
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	.631	2.0	1.259	1.585	.355	.126	9.0	2.818	7.943	.158	.0251	16.0	6.310	39.81
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	.501	3.0	1.413	1.995	.316	.100	10.0	3.162	10.00	.141	.0200	17.0	7.079	50.12
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	.398	4.0	1.585	2.512	.282	.0794	11.0	3.548	12.59	.126	.0159	18.0	7.943	63.10
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.845	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	.316	5.0	1.778	3.162	.251	.0631	12.0	3.981	15.85	.112	.0126	19.0	8.913	79.43
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	.251	6.0	1.995	3.981	.224	.0501	13.0	4.467	19.95	.100	.0100	20.0	10.000	100.00
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42					
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89		10^3	30		10^3
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38	10^2	10^4	40	10^2	10^4
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88					
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39	10^3	10^5	50	10^3	10^5
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91		10^6	60		10^6
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44	10^4	10^7	70	10^4	10^7
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99		10^8	80		10^8
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55		10^9	90		10^9
										10^5	10^{10}	100	10^5	10^{10}
											10^{11}	110		10^{11}
										10^6	10^{12}	120	10^6	10^{12}

RETURN LOSS VS VSWR