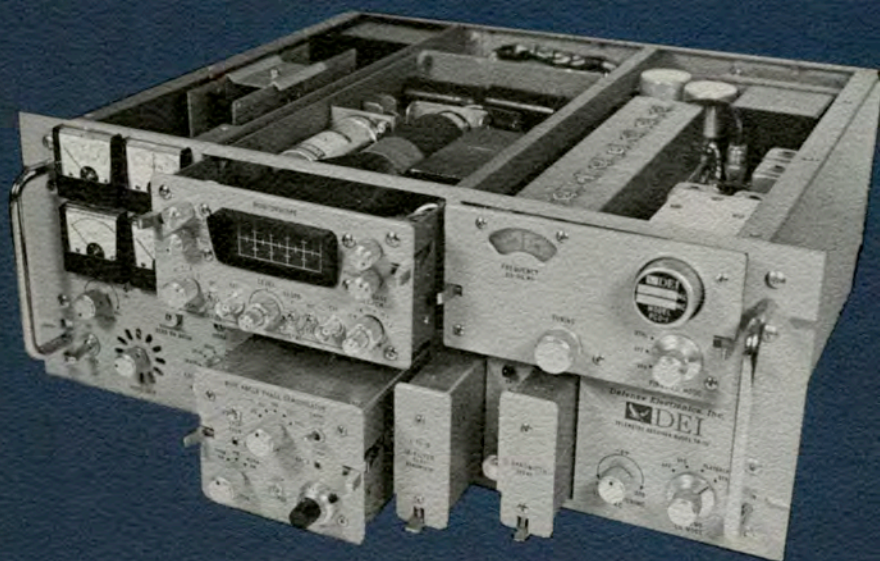


MODEL TR-711

SOLID STATE RECEIVER

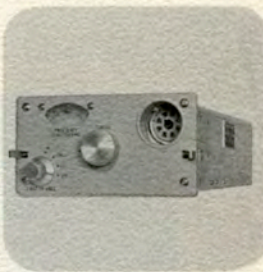


TR-711 SERIES RECEIVER WITH PLUG-IN MODULES PARTLY EXTENDED SHOWING VHF R-F TUNER, "MONITORSCOPE" OSCILLOSCOPE, DUAL IF FILTERS, AND WIDE ANGLE PHASE DEMODULATOR.

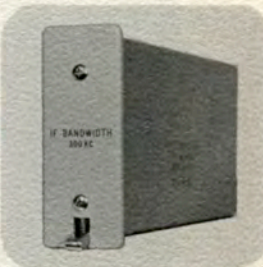
Salient Features

- 55 to 2300 mc Tuning Ranges
- Maximally Linear AGC
- Superior Intermodulation and Adjacent Channel Rejection
- Direct Indication of Carrier Deviation in Kilocycles
- Minimum Limiter "Drop-Out" on Tape Playback
- Long-loop ϕ Demodulators for All IRIG Tuning Ranges
- 10 mc Discriminator Calibration Oscillator
- Switch Selectable IF Filters
- Plug-in Record/Playback Converters
- Plug-in Spectrum Analyzer and Oscilloscope

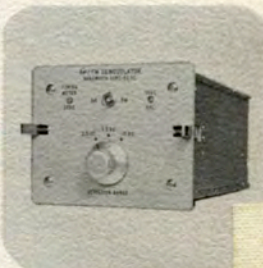
T-711 Series
RF Tuner



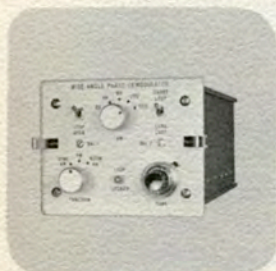
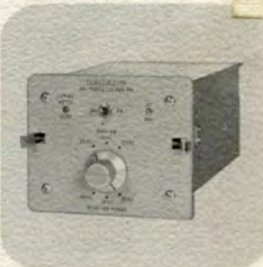
I-711 Series
IF Filter



D-711 Series
AM/FM Demod



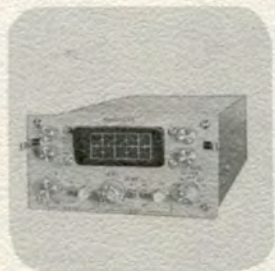
L-711 Series
 ϕ Lock Demod



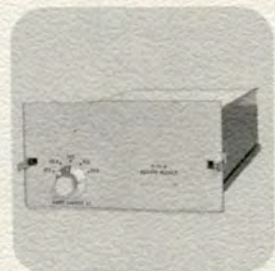
ϕ -711 Series
Phase Demod



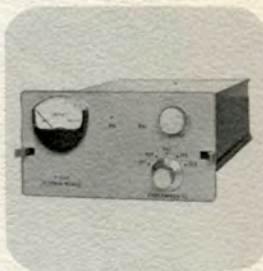
S-711-A
Spectrum
Analyzer



S-711-O
Oscilloscope



P-711-R
Record
Converter

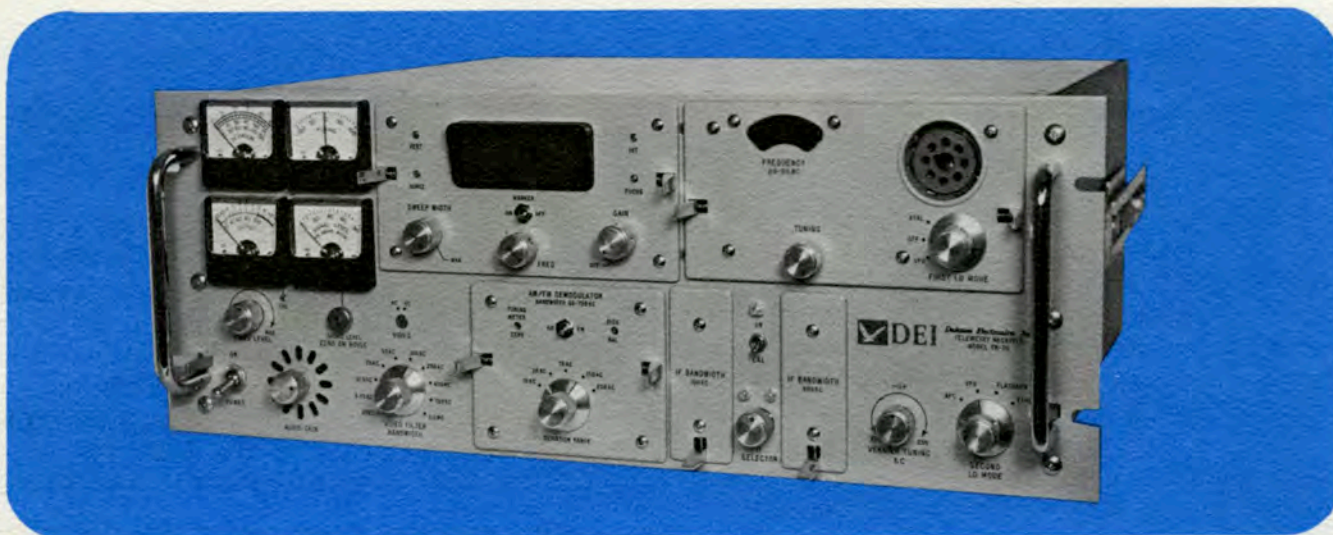


P-711-P
Playback
Converter

Courtesy of <http://BlackRadios.terryo.org>



Defense Electronics, Inc.



TR-711 SOLID STATE RECEIVER

General

The Model TR-711 Solid State receiver is a thoroughly field proven addition to the quality line of telemetry receiving equipment that has earned for DEI the reputation of superior engineering features, quality performance and reliability among aerospace customers throughout the world. The Model TR-711 Receiver continues the proud tradition of the TMR-1, TMR-2A and the TMR-5A Receivers that have set the standard at national telemetry ranges.

One of the primary design goals achieved in the Model TR-711 was an order of magnitude improvement in strong signal handling capability and reduction of spurious response common in previously available solid state receivers. Other significant improvements include extremely linear AGC for accurate signal strength recording and matched AGC performance curves for optimum diversity combiner operation. Multisection tunable preselectors are provided ahead of the first RF amplifier or mixer stages for maximum intermodulation and adjacent channel interference rejection, while improved mixer design virtually eliminates spurious responses and over-driven limiters minimize "drop-out" during tape playback. Optional features such as long loop "pulling" around the first local oscillator permit phase demodulation on all IRIG tuning ranges, including S-Band. Switch selectable IF filter bandwidths and a 10 mc crystal controlled calibration oscillator are also optional. A special TR-711-C Model receiver is available to meet RFI requirements of MIL-I-6181-D.

The TR-711 is truly designed with the user in mind. Modular construction is employed through-

out to achieve the utmost in versatility and to minimize receiver obsolescence. A complete complement of front panel plug-in modules are available, including RF tuning units from 55 to 2300 mc and IF filters with bandwidths from 10 kc to 3.3 mc. Other optional plug-in modules are: AM/FM, Phase-Lock, Phase and High Capture Ratio Demodulators, Spectrum Analyzers, Oscilloscopes and individual Predetection Down/Up Converters. Any combination of these plug-in modules can be utilized, thus providing almost unlimited receiving combinations adaptable to any known or projected telemetry system or modulation format.

The TR-711 is also designed for rapid interchangeability of modules. RF tuners as well as all other types of plug-in modules are secured in place by spring loaded latch-locks. A unique finger-activated mechanism releases the module with sufficient force to partially extend it from the front panel to facilitate easy removal and replacement. In the event of accidental release, the module will continue to function normally because it is not electrically disconnected until it is physically removed from the receiver. Provisions are also made for optional front panel activated latch release mechanisms when the receiver is used with standard equipment slides.

Power transformers and reactors are hermetically sealed and all components are substantially derated to ensure maximum life and reliability. Superior mechanical and electrical design, low power consumption, 110/220V AC, 50 to 400 cycle operation and high reliability make the TR-711 ideally suited for aircraft, mobile van, shipboard and world-wide installations where such features are mandatory.

Description—Model TR-711 Receiver Chassis

Circuitry in the Model TR-711 chassis is all solid state. This includes the power supply and modular subassemblies consisting of the 30 mc first IF amplifier, the 10 mc second IF amplifier, the audio amplifier and all metering circuitry. To simplify interface requirements of plug-in modules, the associated subassembly RF inputs and outputs are 50 ohms.

A functional block diagram is included in this brochure to aid in understanding the circuitry involved and the functions of various plug-in modules available with this receiver.

One of the many exclusive features in the TR-711 is the extremely linear AGC performance exhibited over the entire dynamic range of the receiver. This is achieved by a unique application of voltage controlled attenuator networks which provide accurate proportional AGC "Straight Line" attenuation not available with conventional AGC circuitry. This feature assures precise signal strength recording and matched AGC performance when two or more receivers are used with AGC weighted diversity combiners. (See Typical TR-711 AGC Curve on page 14.)

The Video Amplifier has a front panel screwdriver selector switch for either DC or AC coupling. In the DC mode, the receiver is suitable for television reception where sync preservation and DC restoration is important. DC coupling also permits very low rate PCM signal reception where DC response is essential to avoid "saw-toothing" and accompanying loss of data. A special 6 mc receiver IF bandwidth and a wide bandwidth video amplifier can also be supplied to order for 6 mc resolution of single or double sideband AM television signals.

The TR-711 main chassis contains the second local oscillator, a second LO mode selector switch, deviation meter circuitry, tuning meter circuitry, switch selectable low pass video filters, an AGC amplifier and an optional 10 mc calibration oscillator. The latter is crystal controlled and permits precise discriminator calibration and tuning meter adjustments. This is of particular value for system installations since Tuning Meter calibration can be very quickly checked on a large number of receivers. It also allows center-frequency drifts or offsets to be detected when playing back Pre-D data.

Optional, maximally linear phase response, low pass video filters are available with 3 db re-

sponse of 6.25, 12.5, 25, 50, 100, 250, 400 and 750 kc and 2.0 mc. They are switch selectable from the front panel and all provide an asymptotic slope of 36 db per octave except in the 2 mc position which is 6 db per octave. Video filters supplied in Model TR-711(5) receivers are the same as above except that the slope is 18 db per octave between 6.25 and 750 kc and 6 db per octave at 2.0 mc. (See back page for Chassis Options.)

An internal receptacle and a "Special" switch position on the video filter selector switch is provided for plug-in filter modules with different cut-off frequencies and/or phase characteristics. Special internal plug-in type video filters can be specified to order by contacting Defense Electronics' Sales Department.

Additional flexibility can be achieved with optional dual IF filters which allow instantaneous switching between any two plug-in IF filter bandwidths selected. (See Dual IF Filter Option on page 3.) Model TR-711(5) receivers offer only one filter slot and no front panel selector switch.

Another important feature in the TR-711 is the multi-scale frequency deviation meter which is calibrated directly in kilocycles rather than percentage of IF bandwidth. Thus confusing mathematical computations required by some receivers to determine actual carrier deviations are eliminated.

The deviation range selector switch on AM/FM and Phase-Lock FM Demodulators offers the extra advantage of extreme accuracy when low deviations are used with wide IF bandwidths. This feature also allows measurement or set-up of individual FM/FM subcarriers in a multiplexed FM/FM signal. Additionally, the deviation meter indicates directly in degrees when ϕ demodulators are used in lieu of standard FM demodulators. Furthermore, the signal strength meter and its associated calibration adjustment ensure accurate indication of signal level in db above noise independent of IF bandwidth and RF tuning modules in use.

The foregoing improvements in receiver design are but a few of the many unique features that make the TR-711 the new telemetry standard. For the optimum in present and future receiver performance, please incorporate appropriate specifications as follows:

Specifications—Model TR-711 Receiver Chassis

Type Receiver Modular, double conversion solid state AM, FM or PM Superheterodyne.

Input Impedance Operates from 50 ohm source.

First IF Amplifier 30 mc.

Second IF Amplifier 10 mc, bandwidth determined by plug-in IF filter (see I-711 Series IF filter chart). 6 mc IF bandwidth and 6 mc IF filter available on special order for 6 mc resolution of AM television signals.

Second LO Characteristics:

- Modes of Operation**
- 1) VFO 40 mc oscillator provides vernier tuning of ± 250 kc, stability $\pm 0.002\%/^{\circ}\text{C}$.
 - 2) XTAL controlled 40 mc oscillator, stability $\pm 0.005\%$.
 - 3) AFC (see specifications).
 - 4) Playback, disables front end for predetection playback operation.

Wideband Video Amplifier (AC or DC Coupled)

Frequency Response (AC Coupled) Within ± 1.0 db from 5 cps to 2.0 mc; within ± 0.5 db from 100 cps to 500 kc.

Video Frequency Response (DC Coupled) Within ± 1.0 db from DC to 2.0 mc; within ± 0.5 db from dc to 250 kc.

Output Load 75 ohms

Rated Output 4 volts, peak-to-peak.

Distortion Less than 0.5% at rated output.

Maximum Output 10 volts, peak-to-peak with less than 2% distortion.

Video Bandwidth Maximally linear phase response, low pass filters with switch selectable 3 db response at 6.5, 12.5, 25, 50, 100, 250, 400, and 750 kc and 2.0 mc. (See Video Filter Specifications).

Automatic Gain Control Characteristics

Linearity AGC output varies logarithmically over dynamic range of receiver. (See Typical AGC Curve).

AGC Decay Time 100 ms for AM, 1.0 ms for FM

AGC Control IF signal level at input of FM limiter prior to frequency demodulation (or AM detector input) varies approximately ± 1.5 db over dynamic range of receiver.

Manual AGC (Optional) Please specify if required.

AM Stability AM output within ± 1.5 db with input variations from 10 uv to 100 mv.

Dynamic Range Less than 2% distortion will be measured at video output with input carrier varied from -100 dbm to -7 dbm (100 mv) when using a 500 kc IF bandwidth, a modulation index of 5, a modulation frequency of 10 kc and a video filter setting of 25 kc.

Automatic Frequency Control

Acquisition Range $\pm 50\%$ of the IF bandwidth. (± 500 kc maximum).

Tracking Range $\pm 50\%$ of the IF bandwidth (± 500 kc maximum).

Drift Reduction Factor Approximately 40.

Carrier Signal-To-Noise 6 db minimum for above acquisition range.

Variable Duty Cycle Signals Variable duty cycle signals such as PCM/FM or PDM/FM will be accurately placed within the passband of the receiver for duty cycles between

10% and 90% and for pulse rates between 250 and 800,000 bits per second by the AFC.

Limiting Limits on noise with no signal input.

Dual IF Filters (Optional) If required, please specify as follows: "An electrically connected switch and two plug-in IF filter slots shall be provided in the receiver front panel to permit instantaneous switching between any two plug-in filter bandwidths selected", (Only one filter slot and no selector switch is provided with standard receivers).

Calibration Oscillator (Optional) If required, please specify as follows: "A crystal controlled 10 mc calibration oscillator operated by a front panel switch shall be provided to facilitate accurate discriminator calibration and tuning meter adjustments and to adjust for minimum distortion and maximum data accuracy when playing back predetection data with narrow band IF amplifiers".

Video Filter 36 db Per Octave Slope (Optional) If required, please specify as follows: "Maximally linear phase response, low pass video filters, switch selectable from front panel shall be provided with 3 db response of 6.25, 12.5, 25, 50, 100, 250, 400 and 750 kc and 2.0 mc with an asymptotic slope of 36 db per octave except in the 2.0 mc position which shall be 6 db per octave".

Video Filter 18 db Per Octave Slope Standard, phase linear, low pass filters have a 3 db response of 6.25, 12.5, 25, 50, 100, 250, 400 and 750 kc and 2.0 mc with an asymptotic slope of 18 db per octave except 6 db in the 2.0 mc position.

Metering:
Tuning Meter Indicates correct tuning on all IRIG telemetry signals (see optional calibration oscillator above).

Signal Strength Indicates signal strength in db above noise. Meter and calibration adjustments on front panel permit accurate indication of signal level, independent of IF bandwidth and RF tuning modules in use.

Frequency Deviation Full scale ranges determined by plug-in demodulators. Meter is calibrated directly in kilocycles rather than percentage of IF bandwidth for direct indication of carrier deviations. Phase modulation is indicated directly in degrees when \emptyset demodulators are employed.

Video Output Reads video output level in db.
Aural Monitoring Built in gain controlled audio amplifier and front panel speaker.

Front Panel Controls

Video Level Controls amplitude of video output.
Audio Gain Controls gain to front panel speaker.
Signal Level Calibrates signal level in db above noise, independent of IF bandwidth or RF tuner modules in use.

ON/OFF Power control switch.

AC/DC Video Selects AC or DC coupling to video amplifier.

CAL Screwdriver zero db adjustment for video output meter.

- Video Filter Bandwidth** Selects low pass filters at 6.25, 12.5, 25, 50, 100, 250, 400, 750 and 2000 kc with 18 db per octave slope (36 db per octave slope optional, "Special" position for optional plug-in filter).
- Selector (Optional)** An optional selector switch is available to permit instantaneous switching between any two plug-in IF filters used. (See Dual IF Filter under TR-711 Receiver Chassis Specifications).
- Vernier Tuning, KC** Tunes 2nd LO \pm 250 kc when second LO mode switch is set to "VFO" position.
- Second LO Mode** Switches 2nd LO to AFC, VFO, PLAYBACK or XTAL modes of operation.
- Output / Input Rear Apron Connectors**
 - 1) 30 mc output to spectrum display unit.
 - 2) AGC record output. Negative voltage varies from 0 to - 6 volts with receiver inputs from 0 to 50 mv. Used for signal strength recording or controlling diversity combiners.
 - 3) FM, AM and PM video output. Rated output 4 volts peak-to-peak; 10 volts peak-to-peak maximum.
 - 4) Linear predetection recording output before limiting; 80 mv nominal, 120 mv maximum.
 - 5) Non-linear predetection output recording after limiting; 80 mv nominal, 120 mv maximum. (Except \emptyset -711B.)
 - 6) Predetection playback input; 50 mv nominal.
 - 7) First LO output monitor for frequency counter, 50 ohms isolated.

8) RF input, 50 ohms nominal.

Environmental Performance

Operating Temperature

Range 0° to +50°C.

Storage Temperature Range

Designed to meet - 62° C to + 65° C.

Atmospheric Pressure

Designed to meet storage conditions to 50,000 feet above sea level (3.42 inches of mercury). Operational to 10,000 feet above sea level.

Humidity

To 95% in accordance with Procedure 1. Condition B of MIL-E-4970-A and Procedure 1 of MIL-E-5277-C.

Vibration

In accordance with Type 1 Vibration per MIL-Standard 167. (Shock or non-shock mounted).

Quality Control

In accordance with specifications MIL-O-9858A, MIL-I-45208A and MIL-C-45662A.

Physical Characteristics

Complete Receiver

7" x 19" x 16", designed for mounting in a standard rack. Receiver has provisions for front panel activated latch release mechanisms when used with standard equipment slides. (See Accessories.)

Weight

Approximately 40 pounds with normal module complement.

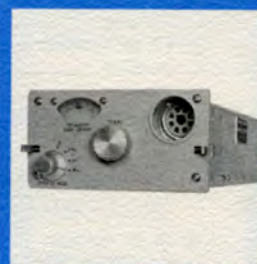
Panel Finish

Light gray # 26329 per MIL-E- 14270, Fed. Std. 595. (Other finishes available on special order.)

Power Input

115/230 VAC, 50 to 400 cps, approximately 50 watts with normal module complement.

MODEL T-711 SERIES RF TUNERS



Description—Model T-711 Series RF Tuners

Optional T-711 Series RF Tuners are plug-in modules which may be quickly installed and removed from the receiver front panel. The tuning mechanism is low-torque, virtually free from backlash and accurate to better than \pm 1%.

RF tuners operating in the VHF range of 55 to approximately 500 mc are all solid state except for RF amplifier stages which incorporate gain controlled, wide dynamic range nuvistors in cascaded circuits to ensure greater signal handling capability and to prevent high-power RF burn-outs which occasionally occur with solid state RF amplifiers.

Double-tuned preselection is also used ahead of RF amplifiers for low noise and greatly improved intermodulation as well as adjacent channel interference rejection outside the RF passband. An optional VCXO with long-loop "pulling" is available

for PM reception. VHF Tuners with this feature are designated as T-711-A(2), T-711-B(2), T-711-C(2) and T-711-E(2).

RF tuners operating in the UHF range from approximately 1000 to 2300 mc and above (on special order) are all solid state. They include four cavity tuned RF preselectors ahead of the first mixer stage for low noise, minimum intermodulation and maximum adjacent channel interference rejection outside the RF passband. First LO frequency multipliers employ step recovery diodes and mixers use strip-line techniques for maximum local oscillator radiation reduction and compact design. An optional VCXO with long-loop "pulling" is also available for PM reception in the UHF range. UHF tuners with this feature are designated as T-711-F(2) and T-711-H(2). Please select required RF tuner(s) from specifications on the following page.

Specifications—Model T-711 Series RF Tuners

- Choice of Frequency Range (s)**
- 1) XTAL controlled or continuously tunable from 105 to 155 mc (T-711-A).
 - 2) XTAL controlled or continuously tunable from 215 to 320 mc (T-711-B).*
 - 3) XTAL controlled or continuously tunable from 285 to 410 mc (T-711-C).
 - 4) XTAL controlled or continuously tunable from 370 to 480 mc (T-711-E).
 - 5) XTAL controlled or continuously tunable from 1435 to 1540 mc (T-711-F).
 - 6) XTAL controlled or continuously tunable from 2200 to 2300 mc (T-711-H).
 - 7) Continuously tunable only from 55 to 260 mc (T-711-J).
- Notes: Other tuning ranges available to order.
*215-315 mc for T-711-B(2).

Intermediate Output Frequency 30 mc.

- Noise Figure (s)**
- 1) 6 db maximum over range of 105 to 155 mc (T-711-A).
 - 2) 7 db maximum over range of 215 to 320 mc (T-711-B).
 - 3) 8 db maximum over range of 285 to 410 mc (T-711-C).
 - 4) 9 db over range of 370 to 480 mc (T-711-E).
 - 5) 11 db maximum over range of 1435 to 1540 mc (T-711-F).
 - 6) 11 db maximum over range of 2200 to 2300 mc (T-711-H).
 - 7) 7.5 db maximum over range of 55 to 260 mc (T-711-J).

Input Impedance Operates from 50 ohm source.

- Image Rejection(s)**
- 1) 60 db minimum, 85 db nominal over range of 105 to 155 mc (T-711-A).
 - 2) 60 db minimum, 75 to 85 db nominal over range of 215 to 320 mc (T-711-B).
 - 3) 60 db minimum, 75 to 85 db nominal over range of 285 to 410 mc (T-711-C).
 - 4) 50 db minimum over range of 370 to 480 mc (T-711-E).
 - 5) 60 db minimum, 75 db nominal over range of 1435 to 1540 mc (T-711-F).
 - 6) 60 db minimum, 75 db nominal over range of 2200 to 2300 mc (T-711-H).
 - 7) 50 db minimum, 58 db nominal over range of 55 to 260 mc (T-711-J).

- IF Rejection(s)**
- 1) 80 db minimum, 100 db nominal over range of 105 to 155 mc (T-711-A).
 - 2) 80 db minimum, 100 db nominal over range of 215 to 320 mc (T-711-B).
 - 3) 80 db minimum, 100 db nominal over range of 285 to 410 mc (T-711-C).
 - 4) 80 db minimum over range of 370 to 480 mc (T-711-E).
 - 5) 80 db minimum, 100 db nominal over range of 1435 to 1540 mc (T-711-F).
 - 6) 80 db minimum, 100 db nominal over range of 2200 to 2300 mc (T-711-H).

7) 60 db minimum, 90 db nominal over range of 55 to 260 mc (T-711-J).

Spurious Responses More than 60 db below fundamental frequency response except 55 to 260 mc range (T-711-J) which is 50 db below fundamental frequency response.

Spurious Emission Oscillator radiation within limits specified in MIL-I-6181-D.

Preselection VHF Range Double tuned preselection is provided ahead of VHF amplifiers for low noise and to minimize intermodulation and adjacent channel interference outside the RF passband (single tuned preselection is used with 370 to 480 mc RF tuner (T-711-E).

Preselection UHF Range A Cavity tuned RF preselector is provided ahead of the UHF mixer stage for low noise and maximum intermodulation and adjacent channel interference rejection outside the RF passband.

Intermodulation No output indication is produced when two sine wave signals, whose sum or difference frequency is equal to any tuned frequency within the passband of the receiver, are simultaneously applied to the input terminals to the receiver. The two test signals are at least a 50 mv level with one signal 30% amplitude modulated at a 1000 cps rate and the second signal 30% amplitude modulated at a 400 cps rate. Either of these signals, when applied alone, produce no detectable output. Any response indicated by the AM detector output in excess of a $\frac{S + N}{N}$ ratio of 6 db is unacceptable. (The 370 to 480 mc tuning range (T-711-E) will not meet this specification because of single tuned preselector ahead of RF amplifier stage).

First LO Modes

VFO Continuously tunable with $\pm 0.001\%/^{\circ}\text{C}$ stability.

XTAL

- 1) $\pm 0.005\%$ stability without crystal oven.
- 2) $\pm 0.0005\%$ stability with crystal oven assembly.

Note: Please specify desired frequency of RF input signal and crystal stability when ordering.

Off Disables 1st LO during Pre-D playback operation.

Phase (Optional) RF Tuner(s) covering a range of 105 to 155 mc, 215 to 315 mc, 285 to 410 mc, 370 to 480 mc, 1435 to 1540 mc or 2200 to 2300 mc (please specify appropriate range(s)) are capable of receiving phase modulated signals when they are designated as T-711-A(2), T-711-B(2), etc. These RF tuners include a VCXO in the first LO, "pulled" by a long loop control voltage from a separate front panel plug-in phase demodulator to compensate for Doppler and overall system frequency drifts to within $\pm 0.007\%$ of received center frequency, including S-Band.

When Ordering Crystals Please specify VCXO frequency or frequencies by stating frequency of RF input signal(s) if reception of \emptyset modulated data is required.

MODEL I-711 SERIES IF FILTERS



Description—Model I-711 Series IF Filters

Optional I-711 Series front panel plug-in IF filter modules are designed for use with the Model TR-711 Receiver to determine the second IF amplifier bandwidth. Models I-711-A through I-711-D contain two amplifiers and a crystal filter assembly, Models I-711-E through I-711-J contain a seven pole LC network. Model I-711-E also contains an input amplifier.

An optional switch and two optional IF plug-in filter slots are available in the receiver front panel to permit instantaneous switching between any two plug-in IF filters selected. (See Dual Filters in TR-711 Receiver Chassis Specifications.)

Model TR-711(5) Receivers are supplied with one IF filter slot and no front panel IF selector switch.

IF filters and IF demodulators are contained in two separate plug-in modules instead of one combined unit because of resulting economies and greater operational flexibility. An example of this is the wide choice of IF filter modules that can be used with the same IF demodulator **without degrading linearity, sensitivity or capture ratio**. Furthermore, the same IF filter can be used with any type of demodulator selected. (See I-711 Series IF Filter Chart.)

Please specify required plug-in IF filter(s) as follows:

MODEL I-711 SERIES IF FILTER CHART

IF Filter Module	IF Bandwidth, 3 db Points*	AM/FM Demodulator	Phase-Locked FM Demodulator	Phase Demodulator
I-711-A	10 kc	D-711-A	L-711-A	φ-711-A or B
I-711-B	30 kc	D-711-A	L-711-A	φ-711-A or B
I-711-C	50 kc	D-711-A or B	L-711-A	φ-711-A or B
I-711-D	100 kc	D-711-B	L-711-B	φ-711-A or B
I-711-E	300 kc	D-711-B	L-711-B	φ-711-A or B
I-711-F	500 kc	D-711-B or C	L-711-B	φ-711-A or B
I-711-G	750 kc	D-711-B or C	—	φ-711-A or B
I-711-H	1.0 mc	D-711-C	—	φ-711-A or B
I-711-I	1.5 mc	D-711-C	—	φ-711-A or B
I-711-J	3.3 mc	D-711-C	—	φ-711-A or B

*IF bandwidth filters not included above can be supplied to special order. Please contact Defense Electronics, Inc. Sales Department for details.

Specifications—Model I-711 Series IF Filters

Center Frequency	10 mc.
Bandwidth (3 db)	Determined by plug-in IF filter selected, (See I-711 Series IF Filter Chart.)
Bandpass Ripple	± 0.5 db
Selectivity	Approximately 2.5:1 at 60 db/6 db bandwidth ratio.

Symmetry 10% maximum defined as % of symmetry =

$$\frac{(F_1 - F_2) \times 100}{F_1 + F_2}$$

where F_1 is measured from 10 mc to upper 3 db point and F_2 is measured from 10 mc to lower 3 db point.

**MODEL D-711 SERIES
AM/FM DEMODULATORS**



Description—Model D-711 Series AM/FM Demodulators

Optional D-711 Series AM/FM Demodulators are complete solid state subassembly modules that can be quickly inserted and removed from the receiver front panel. They are used to demodulate AM or FM signals at the 10 mc second IF stage in either the AFC or non-AFC mode. As with all plug-in modules, spring loaded latch-locks, finger activated release mechanisms and accidental release protection features are provided.

D-711 Series Demodulators comprise three basic types; narrow for IF bandwidths of 10 to 50 kc, intermediate for IF bandwidths of 50 to 750 kc and wide for IF bandwidths of 500 kc to 3.3 mc. Each demodulator is designed to operate with a separate IF bandwidth determining filter for maximum economy and flexibility as described in the IF filter section.

All modules include a deviation range selector switch. Thus appropriate scales on the receiver's frequency deviation meter, which is calibrated di-

rectly in kilocycles, can be selected to indicate actual carrier deviations. (See Frequency Deviation Meter in TR-711 Receiver Chassis Section.)

A front panel tuning meter zero adjustment and a balance control are provided for discriminator calibration. These adjustments can be further simplified by an optional 10 mc crystal calibration oscillator located in the receiver chassis. This feature is described more fully in the Model TR-711 Receiver Chassis Section.

A front panel AM/FM switch permits selection of either the FM discriminator output or the AM detector output for application to the video amplifier.

A unique type of solid state limiter is also used in D-711 Series Demodulators. The limiter is overdriven by 30 db excess gain to full limiting on thermal noise to ensure minimum Pre-D data loss caused by instantaneous "drop-out" during tape playback.

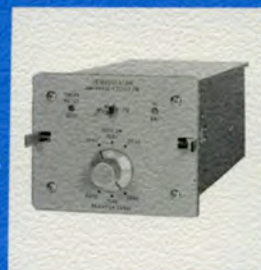
Please specify required AM/FM Demodulator(s) as follows:

Specifications—D-711 Series AM/FM Demodulators

- Range of IF Bandwidth(s)**
 - 1) 10, 30 and 50 kc, determined by plug-in IF filters, (D-711-A). See IF Filter Chart.
 - 2) 50, 100, 300, 500 and 750 kc determined by plug-in IF filter (D-711-B). See IF filter Chart.
 - 3) 500 kc, 750 kc, 1.0 mc, 1.5 mc and 3.3 mc, determined by plug-in IF filter (D-711-C). See IF Filter Chart.
- FM Response (s)**
 - 1) 10 kc and useable to approximately 15 kc (D-711-A).
 - 2) 100 kc and useable to approximately 150 kc (D-711-B).
 - 3) Approximately 1 mc (D-711-C).
- Deviation Meter Scale Selector (s)**
 - 1) 2.5, 7.5 and 15 kc full scale (D-711-A).
 - 2) 15, 25, 75 and 150 kc full scale (D-711-B).
 - 3) 150 kc, 250 kc, 750 kc and 1.5 mc full scale (D-711-C).

- Limiter** Overdriven by 30 db excess gain to full limiting on thermal noise to minimize Pre-D data loss on instantaneous "drop-out".
- Demodulation Modes** High level, low distortion AM or FM outputs are switch selectable from front panel. (Simultaneous AM and FM outputs optional, please specify if required).
- AM Response** 5 cps to approximately 1/2 IF bandwidth (3 db).
- AM Rejection** 50% AM referenced to 100 kc deviation:
 - 1) 400 cps to 10 kc - greater than 50 db.
 - 2) 10 kc to 30 kc - greater than 35 db.
 - 3) 30 kc to 80 kc - greater than 25 db.
- Modulation for Rated Output** 20% or greater.
- AM Distortion** Less than 3% with 90% AM at 1000 cps.

MODEL L-711 SERIES AM/PHASE-LOCKED FM DEMODULATORS



Description—Model L-711 Series AM/Phase-Locked FM Demodulators

Optional L-711 Series AM/Phase-Locked FM Demodulators are complete solid state plug-in modules that can be quickly inserted and removed from the receiver front panel. They are used to demodulate AM or FM signals at the 10 mc second IF stage and are primarily designed to improve the performance of the receiver at low input signal strengths when receiving IRIG FM/FM telemetry data.

L-711 Series Demodulators are available in two basic types; Narrow for IF bandwidths of 10, 30 and 50 kc and Wide for IF bandwidths of 100, 300 and 500 kc. Like the AM/FM Demodulator, these modules are designed to operate with separate IF bandwidth determining filters for maximum economy and flexibility as described in the

IF Filter Section.

Each module includes a unique front panel switch that adjusts data bandwidth for optimum noise rejection. This switch also selects the appropriate meter scale which provides a direct reading in kilocycles to indicate carrier deviations.

Front panel dc balance and tuning meter zero adjustments are provided for ease of calibration. These adjustments can be further simplified by an optional 10 mc crystal calibration oscillator located in the receiver chassis. (See Model TR-711 Receiver Chassis Specifications for details.)

A front panel AM/FM switch permits selection of either the AM detector output or the FM phase detector output for application to the video amplifier.

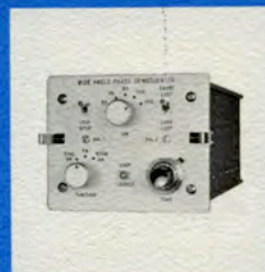
Please specify required AM/Phase-Locked FM Demodulator(s) as follows:

Specifications—Model L-711 Series AM/Phase-Locked FM Demodulators

- Range of IF Bandwidth (s)** 1) 10, 30 and 50 kc, determined by plug-in IF filter, (L-711-A). See IF Filter Chart.
2) 100, 300 and 500 kc, determined by plug-in IF filter, (L-711-B). See IF Filter Chart.
- Data Bandwidth(s)** 1) Switch selectable at 2.5, 7.5 and 12.5 kc for optimum noise rejection (L-711-A).
2) Switch selectable at 25, 75 and 125 kc for optimum noise rejection (L-711-B). Receiver deviation meter scales are also switched to provide corresponding full scale readings.
- AM Response** 5 cps to approximately 1/2 IF bandwidth.

- Deviation for Rated Video Output** 50% of data bandwidth.
- Video Frequency Response** Lower 3 db point 5 cps; Upper 3 db point same as data bandwidth.
- FM Distortion** Less than 2% for full data bandwidth deviation.
- AM Distortion** Less than 3% with 90% AM at 1000 cps.
- AM Rejection** 50% AM referenced to 100 kc deviation:
1) 400 cps to 10 kc - greater than 50 db.
2) 10 kc to 30 kc - greater than 35 db.
3) 30 kc to 80 kc - greater than 25 db.
- Modulation for Rated Output** 20% or greater.

MODEL ϕ -711 SERIES PHASE DEMODULATORS



Description—Model ϕ -711 Series Phase Demodulators

Optional ϕ -711 Series Long and Short Loop Phase Demodulators are complete solid state sub-assembly modules that can be quickly inserted in and removed from the receiver front panel. ϕ -711 Series Demodulators are available in two basic types; Sine Detector for useable ϕ demodulation up to $\pm 70^\circ$ and Wide Angle for linear ϕ demodulation up to $\pm 130^\circ$. Both are used to demodulate PM and AM signals at the 10 mc second IF stage. Front panel, switch selectable PM, AM or synchronous AM demodulation is provided.

ϕ -711 Series Demodulators feature an "adaptive" loop bandwidth. This is achieved by limiting prior to phase detection in order to provide a constant signal plus noise input to the product detector. The phase lock loop is optimized for a signal level producing -15 db S/N. As limiter suppression decreases with increasing S/N, the loop bandwidth widens, allowing a greater Doppler tracking rate. Thus the Doppler tracking rate capability is greatest for strong signals which occur when a satellite passes overhead. Also, the loop is narrowest for weak signals, providing greatest sensitivity such as is required when a satellite is near the horizon. Although Doppler is highest at this time, Doppler rate is approaching zero. For most trajectories, maintenance of phase lock is enhanced by this feature.

Phase lock demodulation is used with PM and synchronous AM video outputs to increase the performance of the receiver at low signal strengths. Switch selectable long and short loop modes are also provided.

In the long loop mode, the demodulator synchronizes on the received RF input signal by means

of a control voltage fed around the first LO and VCXO located in the plug-in RF tuner. This voltage "pulls" the VCXO sufficiently to phase lock the first LO to the RF input carrier frequency. Doppler and overall system frequency drifts are thus compensated to within $\pm 0.007\%$ of the received center frequency on all IRIG tuning ranges, including S-band.

In the short loop mode, the demodulator synchronizes on the 10 mc second IF carrier which is phase controlled by a voltage produced by the phase detector which in turn controls the voltage controlled reference oscillator. Short loop operation is employed when the receiver is used in the Pre-D playback mode.

Front panel tuning meter zero and fine tuning controls are provided for ease of calibration. An optional 10 mc crystal calibration oscillator is also available to simplify calibration and tuning meter centering adjustments. (See Model TR-711 Receiver Chassis Specifications for details.) A front panel switch allows selection of loop bandwidths of 20, 40, 80, 200 or 500 cps. A front panel lamp lights up when the loop is phase locked.

When operating in the PM mode, the receiver's deviation meter indicates phase modulation directly in degrees, thus avoiding confusing mathematical computations.

ϕ -711 Series Demodulators are designed to work with separate IF bandwidth determining filters as with other types of plug-in demodulators. This feature greatly enhances the economy and flexibility of the receiver, especially when a number of different plug-in IF bandwidth filters and/or types of demodulators are needed. (See I-711 Series IF Filter Chart.)

If required, please specify Phase Demodulator(s) as follows:

Specifications—*TR-711* Series Phase Demodulators

Input Signal	10 mc.
Range of IF Bandwidths	10 kc to 3.3 mc, determined by plug-in IF filter (See I-711 Series IF Filter Chart).
Loop Bandwidth	20, 40, 80, 200 and 500 cps, switch selectable. (Other bandwidths to order).
Long Loop Mode	Carrier tracking is phase locked through 1st L.O.
Short Loop Mode	Carrier tracking is phase locked with 10 mc VCO which is phase locked to translated signal carrier.
Long Loop Characteristics	
Tracking Range	± 0.007% (minimum) of received frequency.
Fine Tuning Acquisition Range	± 0.007% of received frequency.
Static Phase Error	10° maximum.
Deviation Range - Model	
<i>TR-711-A</i>	to ± 70°.
Deviation Range - Model	
<i>TR-711-B</i>	to ± 130° (Linear).
Locking Threshold	- 15 db S/N in IF Amplifier.
Short Loop Characteristics	
Tracking Range	± 150 kc minimum.
Fine Tuning Range	± 150 kc minimum.
Static Phase Error	10° maximum.

SPECIAL DEMODULATORS

Non-standard demodulators can be supplied to special order. One example is the High Capture Ratio Demodulator which is designed to improve receiver performance under conditions of extreme multipath such as may be experienced in airborne

Frequency Response	
Phase Demodulation	to 1.5 mc (3 db).
Synchronous AM	10 cps to 250 kc (3 db).
Normal AM	5 cps to approximately 1/2 IF bandwidth (3 db); limited to 500 kc.
Predetection Output	10 mc linear, 10 mc limited 100 mv nominal.
Receiver Phase Deviation Meter	
Model TR-711-A	75° full scale (reads directly in degrees.)
Model TR-711-B	150° full scale (reads directly in degrees.)
Synchronous AM Output	50% AM will produce 1 v rms.
Phase Deviation for Rated Video	
Output	± 30° (4v peak-to-peak. Output 4v.)
AM Distortion	Less than 3% with 90% AM at 1000 cps.
AM Response	5 cps to approximately 1/2 IF bandwidth (3 db); limited to 500 kc.
AM Rejection	50% AM referenced to 100 kc deviation.
	1) 400 cps to 10 kc - greater than 50 db.
	2) 10 kc to 30 kc - greater than 35 db.
	3) 30 kc to 80 kc - greater than 25 db.
Normal AM for Rated Output	20% or greater.

telemetry. Blank modules can also be supplied to allow the user to build custom circuitry for special applications.

Please contact Defense Electronics' Sales Department for details.

SPECTRUM ANALYZER MODEL S-711-A



Description—Model S-711-A Spectrum Analyzer

The optional S-711-A Spectrum Analyzer is a plug-in solid state subassembly module, primarily designed for use with the TR-711 receiver.

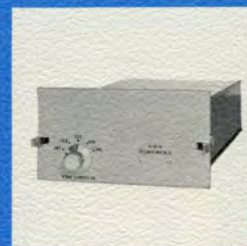
It provides a visual display and a means to visually analyze the signal frequency as well as a band of frequencies adjacent to the signal frequency to aid in the location and identification of interference sources. Crystal controlled 500 kc marker pips provide accurate calibration of the frequency spectrum being analyzed.

The S-711-A features an exclusive on-off switch, independent of center frequency control, to preclude unwanted center frequency shifts associated with activation or deactivation of marker pips.

Specifications—Model S-711-A Spectrum Analyzer

Maximum Sweep Width	4.0 mc.
Center Frequency	30 mc.
Sweep Rate	10 to 20 cps.
Sensitivity for Full Deflection	3 uv into receiver.
Gain Control Range	80 db minimum.
Resolution	10 kc.
Calibration Markers	Crystal controlled with 500 kc marker pips. (Others to order.)
Marker On/Off Switch	Operation independent of center frequency control.
Display Area	1" high x 2-3/4" wide.
Input Power	115 VAC 50 to 400 cps, + 15 V DC, - 15 VDC (obtained from receiver).

**MODEL P-711-R
PREDETECTION RECORD MODULE**



Description—Model P-711-R Predetection Record Module

The optional plug-in P-711-R Predetection Record Module is used to down convert the pre-detected 10 mc, 2nd IF output of the TR-711 receiver to an appropriate tape recorder center frequency such as 900, 450, 225 or 112.5 kc. (Other center frequencies can be supplied to order.)

The P-711-R differs from other types of integral predetection converters in that the module plugs into the front panel of the receiver. It also offers four switch selectable down converted tape recorder center frequencies in the same unit.

If required, please specify as follows:

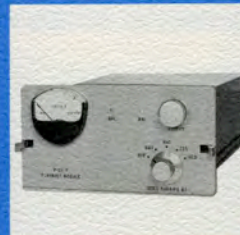
Output Center Frequency	Data Bandwidth (± 1 db)
112.5 kc	150 kc
225 kc	300 kc
450 kc	600 kc
900 kc	1200 kc

Note: Other frequencies available on special order.

Load Impedance	75 ohms
Output Level	4 volts peak-to-peak
Output Constancy	Approximately 1 db over receiver dynamic range.

Local Oscillator	Crystal controlled, stability $\pm 0.005\%$.
Packaging	Each unit is physically interchangeable with plug-in S-711-A Spectrum Analyzer.
Power Requirements	± 15 volts DC (obtained from receiver).

**MODEL P-711-P
PREDETECTION PLAYBACK MODULE**



Description—Model P-711-P Predetection Playback Module

The optional plug-in P-711-P Predetection Playback Module is normally used in conjunction with the P-711-R Predetection Record module in the TR-711 receiver. It up-converts pre-detected tape recorder center frequencies of 900, 450, 225 or 112.5 mc to 10 mc for demodulation in the receiver. (Other center frequencies can be supplied to order.)

Unique features of the P-711-P include front panel plug-in capability and a choice of four switch selectable tape recorder center frequencies in the same unit.

If required, please specify as follows:

Specifications—Model P-711-P Predetection Playback Module

Input Center Frequency Four frequencies selectable by front panel switch.

Input Center Frequency	Data Bandwidth (± 1 db)
112.5 kc	150 kc.
225 kc	300 kc.
450 kc	600 kc.
900 kc	1200 kc.

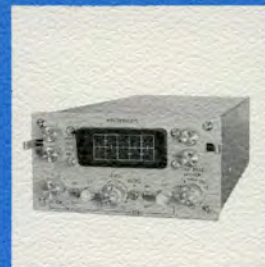
Note: Other frequencies available on special order.

Input Impedance	75 ohms.
Input Level	2 to 10 volts peak-to-peak
Output Center Frequency	10 megacycles.
Output Level	50 millivolts minimum.

Spurious Signal Rejection	
Local Oscillator	40 db minimum.
Image Band	30 db minimum.
Passband	30 db minimum.
Metering	Panel meter provided for monitoring playback input level and oscillator balance.

Local Oscillator	Crystal controlled, stability 0.005%.
Packaging	Each unit is physically interchangeable with the plug-in S-711-A Spectrum Analyzer.
Power Requirements	± 15 volts DC (obtained from receiver).

**"MONITORSCOPE"
MODEL S-711-O**



Description—Model S-711-O "Monitorscope"

The optional S-711-O "Monitorscope" is a complete plug-in general purpose oscilloscope which is physically interchangeable with the Model S-711-A Spectrum Analyzer. It monitors the actual video output of the receiver and thus permits viewing the demodulated signal waveform. Many features found in high performance laboratory oscilloscopes are incorporated such as 1 mc vertical response, calibrated time base and external sync provision. It can be used for modulation waveform and frequency determination, signal-to-noise ratio and threshold observations, video and IF bandwidth checks, effects of various receiver output loading conditions and many other oscilloscope applications.

Specifications—Model S-711-O "Monitorscope"

- Controls** 1) Focus.
2) Intensity.
3) Vertical Position.
4) Horizontal Position.
5) Vertical Sensitivity.
6) Sweep Rate Range & Vernier.
7) Sync. Level and Polarity.
8) Internal /External Input.
9) Internal /External Sync.
- Vertical Sensitivity** 0.5V/cm to 5V/cm.
- Vertical Response** DC to 1 mc.
- Time Base Range** 1.0 cps to 100 kc.
- Synchronization** Free running with adjustable trigger level for either positive or negative slope.
- External Connections** Front panel external signal input and external sync.

ACCESSORIES

Instructions for Ordering Crystals

Model RF Tuner	Type 1st LO Xtal $\pm 0.005\%$ Without Oven	Type 1st LO Xtal $\pm 0.0005\%$ With Oven	Type VCXO Xtal for \emptyset Demod.*	Single Xtal Adapter Assy. for First LO Xtal	Dual Crystal Adapter Assy. for VCXO and First LO Xtal
T-711-A	Model X-1	Model X-2	Model X-3	Dwg. B40-594	Dwg. C34-520
T-711-B	Model X-1	Model X-2	Model X-4	Dwg. B40-594	Dwg. C34-520
T-711-C	Model X-1	Model X-2	Model X-1	Dwg. B40-594	Dwg. C34-520
T-711-E	Model X-1	Model X-2	Model X-3	Dwg. B40-594	Dwg. C34-520
T-711-F	Model X-1	Model X-2	Model X-1	Dwg. B40-594	Dwg. C34-520
T-711-H	Model X-1	Model X-2	Model X-1	Dwg. B40-594	Dwg. C34-520

Note: When ordering, please specify required stability, Model RF tuning unit used, desired RF input signal frequency, whether \emptyset demodulation is required and what crystal adapter assembly is needed. (Model X-2 crystals are equipped with an oven and do not require an adapter assembly).

*For long loop operation with (2) suffix RF Tuner.

Test Accessories Kit Model Tak-1

The Model TAK-1 is a complete test accessories kit, economically priced for field testing and alignment of Model TR-711 Series Receivers in accordance with instruction book procedures. It consists of the following items:

1. Test Fixture, Demod. Simulator
2. Test Cable, Extender 30 mc IF Amplifier
3. Test Cable, Extender 10 mc IF Amplifier
4. Extender Card, Video/Audio Module
5. Extender Card, Metering Module
6. Test Cable, Extender IF Filters
7. Test Cable, Extender AM/FM & \emptyset Demod.
8. Test Cable, Extender Coax AM/FM & \emptyset Demod. (3 each)
9. Extender Card, \emptyset Demod.
10. Handle, Card Puller for \emptyset Demod.
11. Test Cable, Extender RF Tuning Unit
12. Test Cable, Extender Coax RF Tuning Unit (3 each)
13. Adapter, 50 ohm, BNC to Clip lead
14. Adapter, BNC to Clip lead
15. Test Cable, Extender Spectrum Analyzer, Oscilloscope & Predetection Down/Up Converters
16. Alignment Fixture, 50 ohm, Spectrum Analyzer
17. Cover, Test, RF Tuning Unit

NOTE: When ordering TAK-1 Kit, please specify Model(s) of tuning unit(s) used so that proper test cover(s) listed in item 17 above can be provided. Kit price includes one test cover.

Rack Slides

Model RSL-10 pull-out slides with tilt locks provide for convenient rack mounting and servicing of the TR-711 receiver. The slides consist of one pair of runners which are mounted on the receiver chassis and two rack mounted slides. As an additional convenience, Model RSL-10 slides can be equipped with the Model RLL-1 Latch Assembly which locks the receiver in the rack during normal operation and permits manually activated front panel release when the receiver is pulled out of the rack for servicing. Please specify RSL-10 Slides and RLL-1 Latch Assemblies as required when ordering.

Ancillary Equipment Tray

The AET Series Ancillary Equipment Tray provides additional space external to the TR-711 receiver, for such plug-in modules as T-711 Series RF Tuners, S-711-A Spectrum Analyzers, S-711-O Oscilloscopes, P-711-R Predetection Record Converters and P-711-P Predetection Playback Con-

verters. Thus even greater flexibility is available with the TR-711 after all module spaces in the receiver chassis are filled.

For example, when one or two RF Tuners and an associated switch assembly module are plugged into the equipment tray and one RF Tuner is plugged into the receiver, instantaneous selection of different tuning ranges and/or frequencies can be achieved with the same receiver. Furthermore, when one or two Spectrum Analyzers and an associated single or dual four position coax switch assembly module are plugged into the equipment tray, each Spectrum Analyzer can monitor from one to four receivers.

The tray assembly is only 3½ inches high and 19 inches wide. It is designed for standard rack mounting and it will accept any combination of two plug-in modules such as the T-711 Series RF tuners, S-711-A Spectrum Analyzer, S-711-O Oscilloscope or P-711 Series Predetection Down/Up Converters plus one plug-in switch module or special power supply module.

A large number of external plug-in module combinations can be supplied with the TR-711 receiver and since many of these require exact specifications, please contact Defense Electronics' Sales Department for details.

Spare Subassemblies

A complete line of spare subassemblies are available with the TR-711 to facilitate and simplify repairs and spare parts inventory. Please contact Defense Electronics' Sales Department for details.

One Year Recommended Spare Parts Kits

Spare parts kits recommended for normal one year operation can be supplied at time of order or subsequently for the TR-711 receiver chassis and associated plug-in modules. Please contact Defense Electronics' Sales Department for details.

Custom Telemetry Equipment Racks and Systems

Completely pre-wired telemetry equipment racks containing any required combination of receivers, patch bays, pre- or post-detection diversity combiners, multicouplers, video tape recorders, predetection down/up converters, FM/FM discriminators, PCM Decommutators and all necessary computer formatting equipment can be supplied for simple data acquisition systems or for complete telemetry installations from the antenna to the computer. These systems are fully interfaced and require minimum time to install and put into operation. For details, please contact Defense Electronics' Sales Department. Also refer to systems photographs on back cover.