

COLLINS **microwave**
systems

RF SYSTEMS

Collins toll-quality radio relay systems provide a reliable, high channel capacity, economical mode of transmission for the common carriers, industry, TV and government. Operation is on one of four bands in the 5925 to 8500 mc frequency range, with transmission and reception of composite signals in a 200 cps to 2000 kc baseband. Five types of systems provide the optimum degree of circuit reliability for the user's requirements consistent with economic considerations.

Q LINE SYSTEM — The Q Line offers reliable, economical, high density communication with utmost simplicity for systems which will not require future expansion to switchover or standby operation. Units are identical to those employed in standard microwave systems.

NON-STANDBY SYSTEMS — A single transmitter and receiver at each terminal station and two each at a repeater station, together with power supplies and associated equipment, comprise this system. If improved circuit reliability is desired at some future time, this configuration may be expanded to include standby or diversity functions.

COLD STANDBY SYSTEMS — A duplicate group of RF and power supply units is included for maximum protection against communication outages from equipment failure. Maintenance may also be performed on the station at any time without interruption of service. Sensing devices detect failure of klystron power output and initiate switchover to energize the standby equipment and, after the proper warm-up period, apply the klystron beam voltage. Solenoid-operated capacitive detuning stubs are used to switch from main to standby equipment. Switchover to full operation on the alternate equipment requires about one minute. An optional sensing system uses a 100-cycle signal applied to the receiver, regulator and modulator of the associated transmitter. The signal is filtered out at the modulator and fed to a sensing detector, which initiates switchover action when the signal is absent.

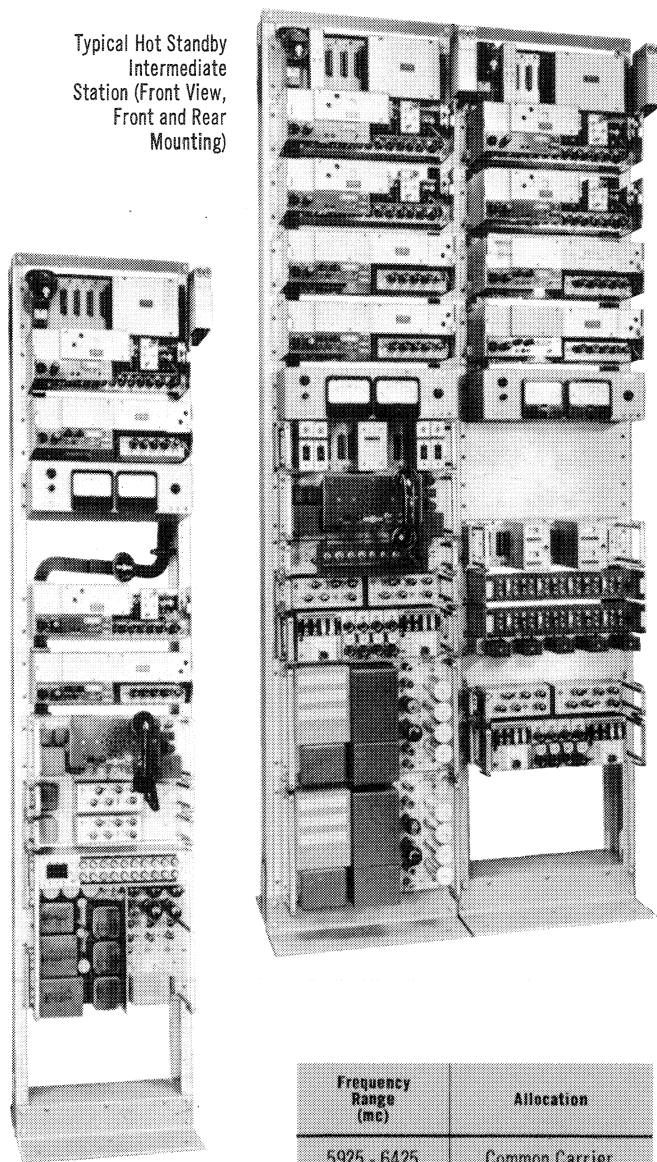
HOT STANDBY SYSTEMS — Both main and auxiliary units are constantly energized and fully operating, permitting rapid switchover in the event of circuit failure. The transfer is effected by the same capacitive detuners employed in the cold standby system.

DIVERSITY SYSTEMS — Maximum reliability is achieved by space or frequency diversity operation in which reception on different frequencies or over two separate signal paths is employed. Without the use of relays, the electronic receiver-output combiner provides a signal-to-noise ratio always equal to or better than that of the best path. With equal signal-to-noise ratio from each receiver, the combined signal-to-noise ratio will be improved 3 db. The combining technique eliminates any delays inherent in a diversity switching method, making the Collins system ideally suited for high speed data handling circuits.

Each equipment configuration is a functionally complete RF system including all transmitting, receiving, power and control equipment necessary for operating from a specified power source. Additional coupling and accessory equipment may be needed in some applications.

Power Output: 100 mw at the waveguide stack (input to antenna). *Transmitter Frequency Stability:* 0.05% (0.01% with AFC). *Type of Modulation:* FM. *Nominal Deviation:* ± 3.0 mc. *Receiver Tangential Threshold Sensitivity:* -118 dbw. *Receiver Noise Figure:* 14 db, including preselector filter. *Receiver Intermediate Frequency:* 60 mc. *IF Bandwidth:* 15 mc at 3 db points. *Receiver Frequency Stability:* 0.05%. *Ambient Temperature Range:* 0° to +140°F. *Maximum Relative Humidity:* 95%. *Maximum Altitude:* 20,000 feet. *Power Source:* 115 v, 50/60 cps or 130 v dc. *Type of Service:* Continuous, unattended operation. *RF Duplexing:* Simultaneous, full duplex, two way communication through a common antenna utilizing waveguide filters and tuned stubs.

Typical Hot Standby Intermediate Station (Front View, Front and Rear Mounting)



Q Line Terminal Station

Frequency Range (mc)	Allocation
5925 - 6425	Common Carrier
6575 - 6875	Operational Fixed
6875 - 7125	Television Relay
7125 - 7650	Government

VOICE CARRIER MULTIPLEX

Upper or lower single sideband suppressed carrier techniques are employed to combine a large number of individual voice channels into a composite baseband signal using frequency division techniques for simultaneous transmission and reception over the microwave RF systems. All power supplies, frequency generating and synchronization equipment, and control circuits associated with these functions are also included. Terminating units connect channel equipment with incoming and outgoing telephone or other communication circuits, with facilities for keying and detecting signaling tones. Channels may be dropped or added at repeaters by bridging onto the baseband.

The system conforms to CCIF standards and is fully compatible with established practices employed in long-haul toll telephone plants.

The incoming audio signal is combined in one of 12 channel modulators with a carrier injection frequency which places the channel in the proper position in the base group. The carrier is one of 12 injection frequencies at 4 kc intervals. Each SSB channel thus occupies a 4 kc space in the base group, which in this case is 60-108 kc.

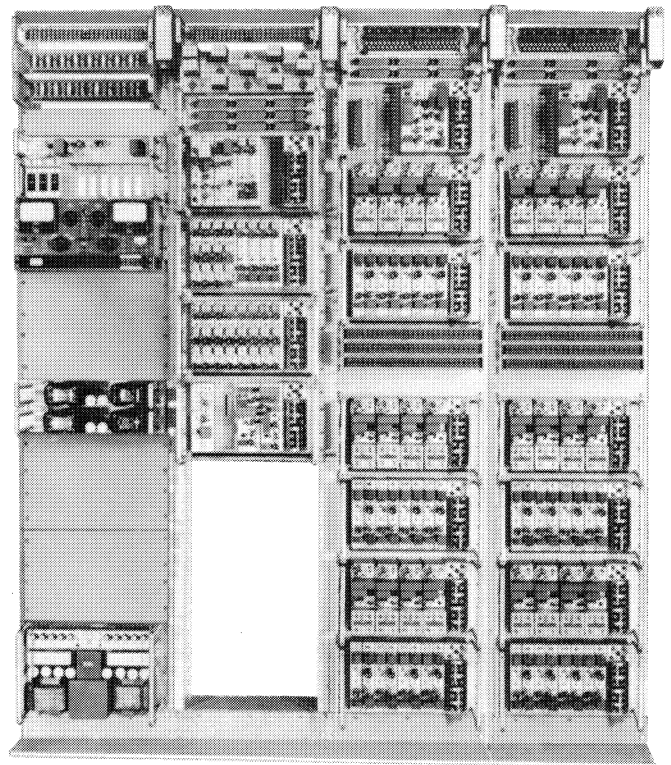
Five base groups are modulated with 5 carrier injection frequencies — 420 kc, 468 kc, 516 kc, 564 kc and 612 kc. The resulting supergroup occupies 312 to 552 kc and consists of 60 voice communication channels.

In a 120-channel system, there are normally two such 60-channel supergroups. One supergroup (312-552 kc) is combined with a 612 kc carrier injection frequency in the supergroup SSB modulator, translating the supergroup to the 60-300 kc portion of the baseband and thus obtaining supergroup I. Supergroup II retains its frequency allocation, passing through combining circuits to the 312-552 kc position on the baseband.

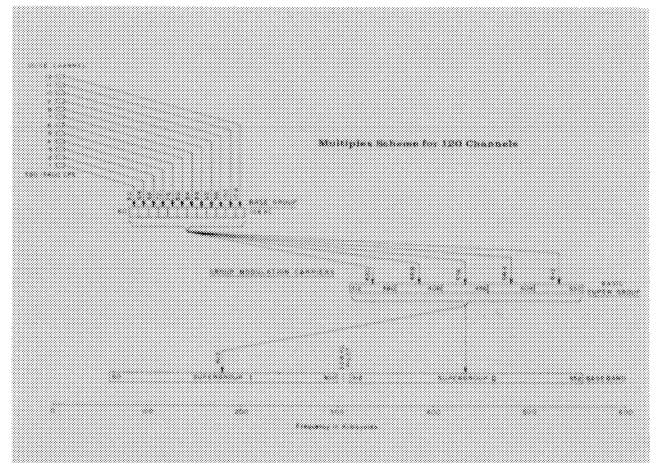
A 48-channel system would require only those modules enabling it to utilize base groups 1, 2, 3 and 4, and supergroup II. A 240-channel system is achieved by adding two more supergroups to the 120-channel system. One of these (312-552 kc) is combined with an 1116 kc carrier injection frequency, translating the supergroup to the 564-804 kc portion of the baseband. Supergroup IV is derived in the same manner except a 1364 kc carrier injection frequency is used, translating the supergroup (312-552 kc) to the 812-1052 kc portion of the baseband. In receive operation, the identical frequency translation scheme is employed in reverse.

The Collins building block design makes possible a wide variation of station configurations within a system or between systems for varied channel requirements. It facilitates expansion of equipment in the future. These systems utilize 8 foot or 11 foot, 6 inch racks. Articulated hinge mountings are available to mount units or shelves to which rear access may be needed, facilitating mounting on both sides of the racks. *Output Frequency Range:* 60-552 kc for 120 channels and 60-1052 kc for 240 channels (compatible with CCIF and U. S. standards). *Number of Carrier Channels:* From 1 to 240 full duplex voice channels can be provided. *AF Response:* ± 2 db, 350-3450 cps, without signaling. ± 2 db, 350-2800 cps, with signaling. *Idle Noise:* Maximum 23 dba on worst channel at 0 dbm level on back-to-back basis (average 17 dba). *Intermodulation:* Maximum 50 db Notch-to-no-notch for loading of -15 dbm per channel, between any two stations. *Standby Provisions:* Standby for all carrier units which are common to more than one channel is available. *Signaling:* Each channel

may be equipped for 3400 cps signaling, utilizing E & M or 20-cycle ringdown. *2/W Termination:* Impedance — 600 or 900 ohms $\pm 10\%$. Output level — Nominal 0 dbm. Input level — Nominal -6 dbm. *4/W Termination:* Impedance — 600 or 900 ohms $\pm 10\%$. Input Level — Nominal 0 dbm. Output level — Nominal 0 dbm. *Frequency Error:* System fully synchronous with zero frequency error throughout. *Power Source:* 115 v, 50-60 cps, 3 kw (120 channels) ac, or 130/24 v dc battery. *Power Consumption:* Approximately 3,000 watts for 120 channel system.



Typical 24-Channel Voice Carrier Multiplex



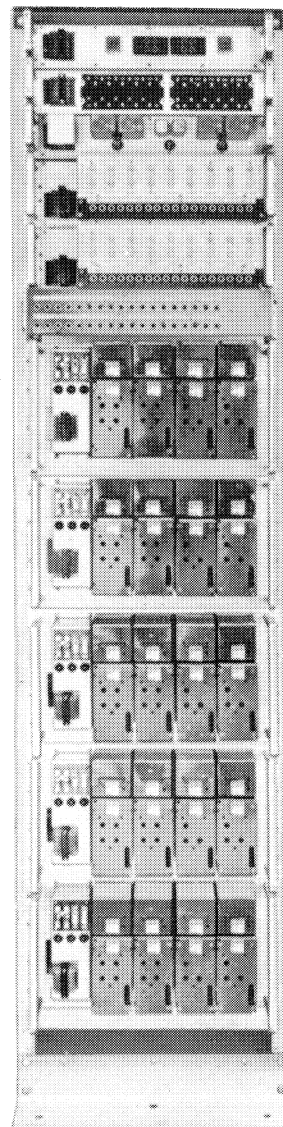
CARRIER TELEGRAPH SYSTEM

TE-302 provides up to 18 or 26 FSK channels for teleprinter (with a TWX function), telemeter or other binary data transmission applications.

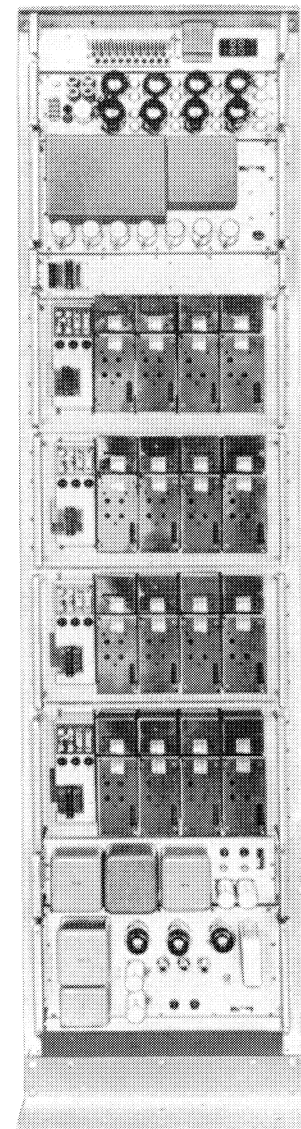
Information from the dc telegraph channels is transmitted by carrier tones separated by 170 cps in the audio range. Eighteen duplex channels can be accommodated on a 4-wire voice circuit or 9 duplex channels on a 2-wire circuit. Another 8 channels may be added optionally above the voice band with frequencies up to 5050 cps. Besides mark and space, a third condition of "no carrier" may be used for supervisory control or fault alarm.

Transmit and receive units for each channel are individual plug-in modules with etched wiring boards for maximum reliability. The module is further subdivided with a submodule containing the bandpass filter and tuned elements. This submodule may be easily removed and replaced for rapid change in channel frequency assignments. Modules are plugged into mounting panels fitting standard 19 inch relay racks. Electron tubes and relays have been eliminated by the use of transistorized circuits. A fully wired, 18 channel terminal, including all common equipment and power supplies, may be accommodated on a 7' rack with front and back mounting. Other configurations are available for 8'8", 9' or 11'6" racks with mounting on front or both sides. The modular concept makes possible initial installation containing fewer than the maximum number of channels, with new channel modules added as communication requirements increase.

The TE-302 may be connected for full duplex or half duplex operation, with capability of back-to-back operation and an option of 62.5 ma or 20 ma loop current. A switch enables selection of either the high frequency or the low frequency for a mark, and the receive unit may be strapped to operate in a steady mark or space condition in the absence of a received signal. If desired for TWX operation, a strap may be installed in the transmit unit so a remote switch can control on-off function. The TE-302 System and options are fully compatible with standard telegraph equipment, such as the Western Electric 43A. *Frequency Allocation:* 26 channels, center frequencies from 425 to 5050 cps. *Transmission Rate:* 60, 75 or 100 wpm. *Maximum Transmit Level:* +6 dbm per channel. *Minimum Receive Level:* -45 dbm per channel. *Bias Distortion:* 5% maximum over any 10 db range between +6 dbm to -45 dbm input signal. *Frequency Stability:* ± 2 cps over environmental range for channels to 3315 cps. For higher frequencies, 5% maximum change. *Line Impedance:* 600 ohms balanced. *Environmental Conditions:* 0°C to +60°C ambient; humidity to 90%. *Telegraph Options:* Full duplex neutral, half duplex neutral and back-to-back operation. *Power Source:* Commercial ac power or office battery 21-30 v dc, 130 v bias battery, and loop telegraph supply +130 v or -130 v. *Power Consumption (per channel):* 27 v at 60 ma, 130 v at 23 ma, plus loop current. *Weight:* Approx. 500 lbs.



TE-302 (Front)



TE-302 (Back)

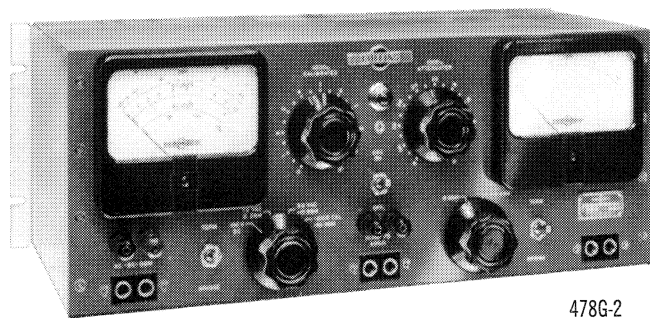
Channel Number	East to West		West to East	
	Send	Receive	Send	Receive
1	425	3315	3315	425
2	595	3145	3145	595
3	765	2975	2975	765
4	935	2805	2805	935
5	1105	2635	2635	1105
6	1275	2465	2465	1275
7	1445	2295	2295	1445
8	1615	2125	2125	1615
9	1785	1955	1955	1785

TEST EQUIPMENT

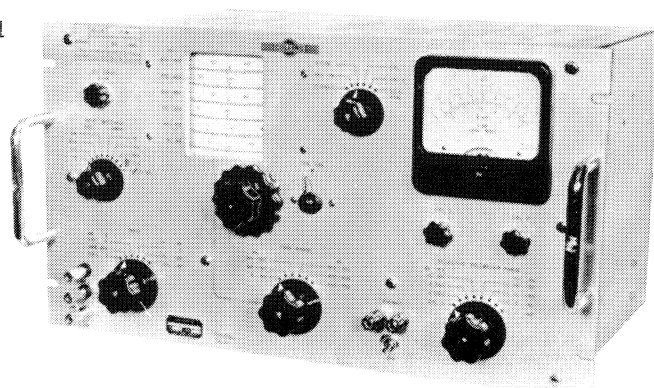
478G-2 TEST PANEL — Facilities for setting line levels of Collins carrier equipment. Includes a signal source, meters and attenuators. *Test Signaling:* 1000 cps, variable +10 to -28 dbm, 600 ohms. *Meter Ranges:* -20 to +12 dbm, 600 ohm impedance, bridging or balanced. *Meter Response:* Essentially flat to 2 mc for signal levels up to 3 v ac. *Power Requirements:* 130 v dc, 10 ma; 6.3 v, .35 amps, or 24 v. *Size:* 19" W, 7" H. *Weight:* 12 lbs.

476J-1 WIDEBAND AND SELECTIVE VOLTMETER — Used to measure harmonic distortion, intermodulation products, cross-talk, attenuation and interfering frequencies of

telephone carrier equipment. **WIDEBAND VOLTMETER** — *Frequency Range:* .2 to 750 kc. *Voltage Range:* 10 to 100 mv, 1 to 10 v. *Accuracy:* ±5%. **SELECTIVE VOLTMETER** — *Frequency Range:* 4 to 750 kc in 6 bands. *Frequency Accuracy:* 2% ±300 cps. *Voltage Measurement Ranges:* 10 uv to 10 v (-100 to +20 db, .775 v reference, 600 ohms). *Background Noise:* Approximately 1.5 uv (2.5 uv in the range 4-10 kc.) *Balanced Input Impedance:* 75, 150, 600, 2000 ohms, min. return loss 20 db. *Unbalanced Input Impedance:* 75, 150, 600, 20,000 ohms, min. return loss 20 db. *Primary Power:* 110/208 v ac, 42-60 cps, 50 va. *Size:* 18 $\frac{1}{8}$ " W, 10 $\frac{3}{8}$ " D, 12 $\frac{1}{8}$ " H. *Weight:* 44 lbs.

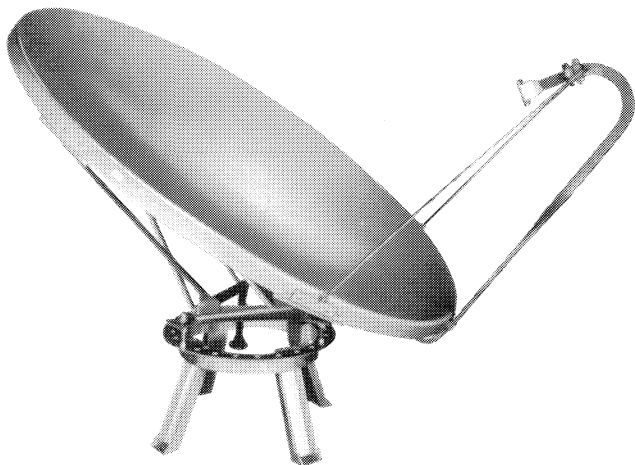


478G-2



476J-1

PARABOLIC ANTENNAS



537E-1

537E OFFSET FEED ANTENNA — The complete antenna system consists of a parabolic antenna normally mounted at the base of the microwave tower or on the roof of the microwave station, together with a tower mounted reflector. The reflector at the top of the tower eliminates long waveguide runs and electrical maintenance of tower mounted components. However, antennas may be mounted either horizontally or vertically as required. An offset waveguide feedhorn makes critical installation adjustments unnecessary. De-iced antenna contains four 115 or 230 volt heating elements with wattage chosen for the normal low temperatures expected in a particular location. Thermostats energize the heaters at approximately 40°F. Antenna is available with or without de-icer. *Wind Loading:* 100 mph. *VSWR:* Less than 1.15:1. *Weight:* 250 lbs. *De-Icing:* Optional. Center Feed paraboloidal antennas are also available in two sizes, with or without de-icer.

Antenna Size	Gain	Beamwidth
5.3' (offset feed)	38.5 db	1.8°
6' (center feed)	39.5 db	1.7°
8' (center feed)	42.0 db	1.4°
(Data at 6700 mc.)		