

**STROMBERG-CARLSON**  
***TRANSMISSION***  
***EQUIPMENT***

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## CARRIER SYSTEMS

### 661A—665A—686A CARRIER TELEPHONE SYSTEMS

These carrier systems permit use of an existing pair of wires for as many as 12 simultaneous speech circuits. In addition, the equipment is completely transistor-operated and of modular construction to save space, provide ease of installation and maintenance, improve reliability, as well as minimize maintenance.

#### Type of Transmission

The 661A and 665A Carrier Systems utilize amplitude-modulated, double-sideband transmission in which speech and signaling frequencies are modulated directly to carrier frequencies at the transmitting end and demodulated to voice frequencies at the receiving end, without an intermediate modulation step. Double-sideband transmission permits the use of relatively simple bandpass filters thereby affecting a substantial saving over other methods.

The 686A Carrier Repeaters operate as broadband amplifiers at carrier frequencies. No change in carrier frequency or characteristics of the carrier channel is involved; the only function is boosting and equalizing the carrier signals to compensate for line loss and slope. As many as three 686A Repeaters can be used on a transmission line.

#### Frequency Allocations

The 661A and 665A Carrier Telephone Systems are available in stacked or grouped frequency arrangements. The stacked arrangement permits maximum utilization of a non-repeated line having high attenuation at the higher frequencies. When line loss requires the use of a repeater, a grouped arrangement is used.

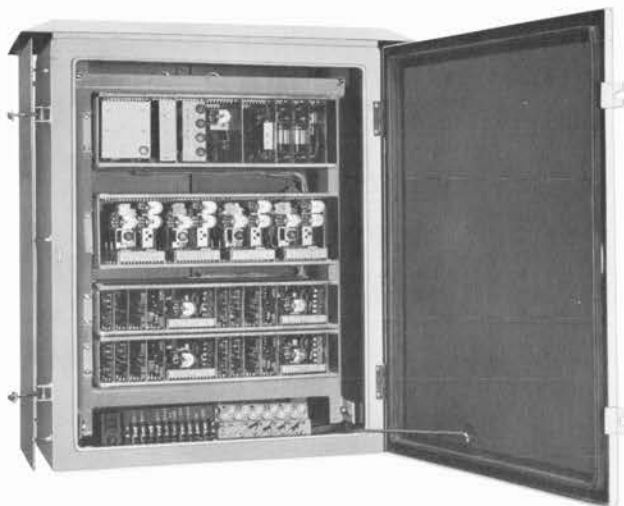
All cards used by both frequency arrangements are identical. The only difference is the frequency assigned to a particular channel. Therefore, a stacked system can be converted to a grouped system by simply interchanging transmit and receive cards between channels to obtain a grouped channel frequency arrangement.

### 661A SUBSCRIBER CARRIER SYSTEM

The Stromberg-Carlson 661A Subscriber Carrier System provides 1 to 12 full-duplex voice channels on a single, voice-frequency telephone circuit. Each channel can serve as many as 10 subscribers with selective ringing of each subscriber. Therefore, one 12-channel carrier system can serve as many as 120 subscribers on one pair of wires in addition to any voice-frequency usage.

#### Power Requirements

Central-office subscriber carrier equipment is usually operated from the 48-volt or 24-volt central-office batteries. Pole-mounted subscriber terminals are usually operated from 117-volt ac power supply. To prevent loss of service during a power failure, standby batteries can be installed adjacent to the subscriber terminal pole-box. The batteries will be automatically recharged from the power supply when power is restored. No separate charger is required.



*661A Subscriber Terminal*

#### Dialing and Ringing

The 661A Subscriber System provides subscriber dialing and central-office ringing of the subscriber. Choice of plug-in cards provides bridged, divided, or superimposed ringing. Frequency selection (harmonic, synchromonic, or decimonic) also coded or non-coded ringing can be used with bridged or divided ringing; coded or non-coded with superimposed ringing.

#### Size

A central-office terminal of 12 channels requires only 26 1/4 inches of vertical space on a 19-inch rack. Each 3 1/2 inch high channel cell accommodates all circuit cards required for two channels. The 5 1/4 inch high common equipment cell mounts the line matching transformer, insertion filter, and power supply regulator.

Subscriber terminals are housed in a sturdy, weatherproof pole box which accommodates four channels together with a 117-volt power supply and common equipment. The pole-box including sun-shade panels is 31 1/16 inches high, 28 1/4 inches wide and 17 inches deep. The battery box, to house standby power, is 24 inches high, 18 13/32 inches wide and 6 1/4 inches deep.

#### Rack Mounting of Subscriber Terminals

661A Subscriber Carrier terminals at the subscriber end may be ordered for mounting on standard 19" relay racks instead of in the usual weather-resistant pole box for applications where a building or some other type of weather proof enclosure is available.

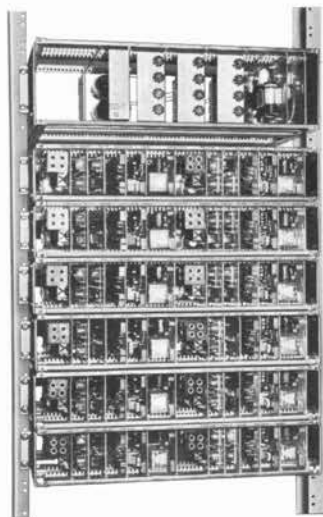
The 686A Repeater may also be ordered rack mounted where the same circumstances apply.

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## 665A TRUNK CARRIER SYSTEM

The Stromberg-Carlson 665 Trunk Carrier System, provides 1 to 12 additional trunk circuits over a normal voice-frequency physical circuit between central offices. The 665A System is available to operate with two-wire or four-wire voice-frequency drops with either one-way loop or E and M signaling.



665A Trunk Carrier Terminal

### Power Requirements

This trunk carrier system is usually operated directly from the 48-volt or 24-volt central-office battery. Operation from 117 volts  $\pm 10\%$ , 50-66 cps can be provided when required; when standby batteries (optional) are used, they are automatically recharged from the 117-volt power supply.

### Repeaters

When line loss exceeds the maximum permissible value of 35 db for channels 1-8 or 45 db for channels 9-12, the 686A Repeater System can be used to extend the operating length of the system.

### Signaling

Trunk signaling options provide arrangements compatible with various telephone exchange requirements. The most common usage is with E and M signaling and tone-off during seizure. Optional jumpers on the signaling card provide other choices such as open and 24-volt, open and 48-volt battery on the M lead; E lead pulsed between open, -48 volts and ground in various combinations.

Direct connection to selector levels can be provided by means of optional, loop-dial cards.

### Size

A fully equipped trunk system of 12 channels requires only 26  $\frac{1}{4}$  inches of vertical mounting space on a 19-inch rack. A channel cell is 3  $\frac{1}{2}$  inches high and accommodates all circuit cards required for two channels. The common equipment cell (power supply regulator, line matching transformer, etc.), measures 5  $\frac{1}{4}$  inches and one is required per 12-channel system.

## 686A CARRIER REPEATER

The Stromberg-Carlson 686A Carrier Repeater permits operation of 661A or 665A Carrier Systems, with grouped frequency arrangement, over long lines and lines with high transmission loss. A 686A Repeater nearly doubles the permissible line-loss over which the carrier system can operate and as many as three repeaters can be used on a transmission line.

### Characteristics

The 686A Repeaters operate as broad-band amplifiers at carrier frequencies. No change in carrier frequencies or characteristics is involved; the only function is to compensate for line loss and slope. The 686A Repeater provides automatic regulation for both directions of transmission. Fixed equalizers, with straps, permit compensation for the difference in loss (slope) across the transmission band.

Each amplifier and associated filters has the bandwidth of several grouped channels. Four amplifiers are used in three repeater combinations. The bandwidth of the amplifiers and associated filters are as follows:

- (1) 8kc-88kc for one direction
- (2) 96kc-204kc for opposite direction
- (3) 292kc-348kc for one direction
- (4) 220kc-276kc for opposite direction

The combinations of amplifiers available in the 686 Carrier Repeaters are:

- (1) Amplifiers (1) and (2) above, for channels 1-8.
- (2) Amplifiers (3) and (4) above, for channels 9-12.
- (3) Amplifiers (1), (2), (3), and (4) above, for all channels.

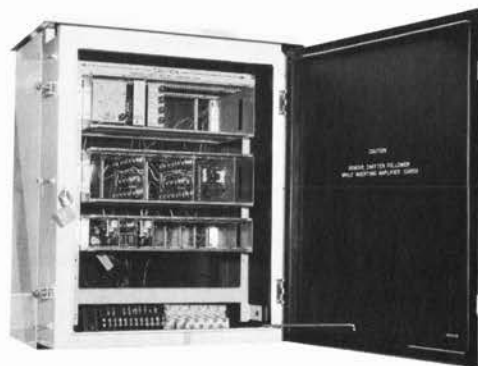
The 686A Carrier Repeaters are available with or without provision for use of the physical circuit at voice frequencies.

### Power Requirements

Pole mounted repeaters require a 117-volt power source. The built-in power supply provides operating voltages as well as battery charging voltage when a standby battery is used to prevent loss of service during a power failure.

### Size

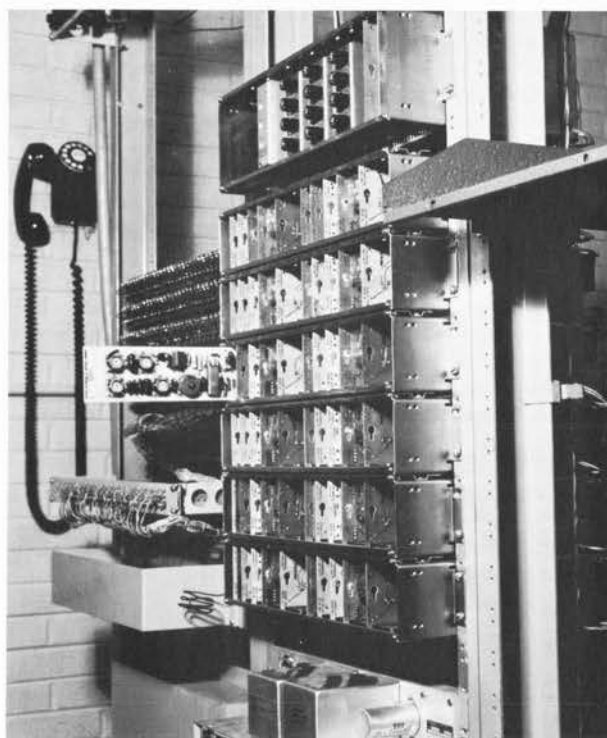
Repeaters are housed in a pole-box, identical in size and description to the subscriber terminals. The box is 31  $\frac{1}{16}$  inches high, 28  $\frac{1}{4}$  inches wide and 17 inches deep and will accommodate all equipment required by a 12-channel, two-direction, 686A Repeater. The battery box, to house standby power is 24 inches high, 18  $\frac{13}{32}$  inches wide and 6  $\frac{1}{4}$  inches deep.



686A Carrier Repeater

### 661A—665A—686A System Performance Specifications

Method of Transmission	Double sideband, amplitude modulated transmitted carrier.
Channel Bandwidth	300-3,000 cps $\pm 1$ —3db referred to 1000 cps
Transmit Carrier Level	+5 dbm, nominal.
Repeater Output Level	+2 dbm, nominal.
Receive Carrier Level:	
Channels 1 through 8	—30 dbm, minimum.
Channels 9 through 12	—40 dbm, minimum.
Drop-Side VF Levels (2-wire):	
Transmit	0 dbm, nominal.
Receive	—4 dbm, nominal.
Drop-Side VF Levels (4-wire):	
Input	—13 dbm or —16 dbm, minimum.
Output	+4 dbm or +7 dbm, maximum.
Carrier-Line Loss (maximum without repeater):	
Channels 1 through 8	35 db.
Channels 9 through 12	45 db.
Subscriber-Drop Loss:	
With ac power supply	1200 ohms loop maximum.
With standby battery but without booster battery	400 ohms loop maximum during ac power failure.
With standby battery and with booster battery	1,200 ohms loop maximum.
Compandor	Required for channel 12 only when repeatered; otherwise optional for channels 1-12. Use depends on line noise and crosstalk conditions.
Power Requirements	Central-office: 48 volts dc or 24 volts dc, 100 ma max per carrier channel. Subscriber or repeater terminal: 117 volts $\pm 10$ %, 50-66 cps, 100 watts max, 30 watts average
Ambient Temperature Extremes:	
Subscriber and Repeater Terminals	Internal —40°F to +149°F; external —40°F to +120°F.
Trunk Terminal	0° to 149°F.
Relative Humidity	up to 95 %.



*Typical installation of 661A Carrier*

Impedance:	
Carrier Line	600 ohms or 150 ohms, balanced.
VF Line, 2-wire	600 ohms or 900 ohms, balanced.
VF Line, 4-wire	600 ohms, balanced.
Repeater	600 ohms or 150 ohms, balanced.
Signaling:	
Subscriber	Carrier keyed off-on.
Trunk	Out of band (3,500 cps), 8 to 20 pps with less than 4 % distortion; E & M, 2-wire and 4-wire.
Dial Speed Limits	Subscriber system will operate with dial speeds of 8 pps to 14 pps; trunk system, 8 to 20 pps.
Ringing (Subscriber)	Bridged or divided, using coded or frequency selective systems (harmonic, synchmonic, or decimonic); superimposed using coded or non-coded.
Revertive	Will operate with any revertive call circuit which alternately rings the calling and called party.

NOTE: Specifications are subject to change due to continuing engineering studies.

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### VOICE-FREQUENCY REPEATERS

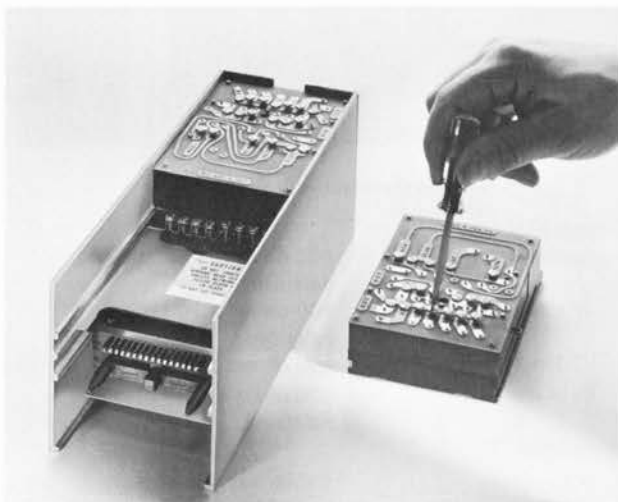
Stromberg-Carlson offers Negative-Resistance, Negative-Impedance and Hybrid type repeaters, in models and combinations to suit every application, for the improvement of transmission over subscriber and trunk line facilities.

Each of the three types is modular in design, using interchangeable, solid state, plug-in componentry. This makes possible the maximum flexibility, while conserving space. Minimal equipment may be ordered and additions or substitutions made as changes to physical plant are completed. Parts inventory can be held to the lowest practical level, since substitutions at one location often release the required componentry for another.

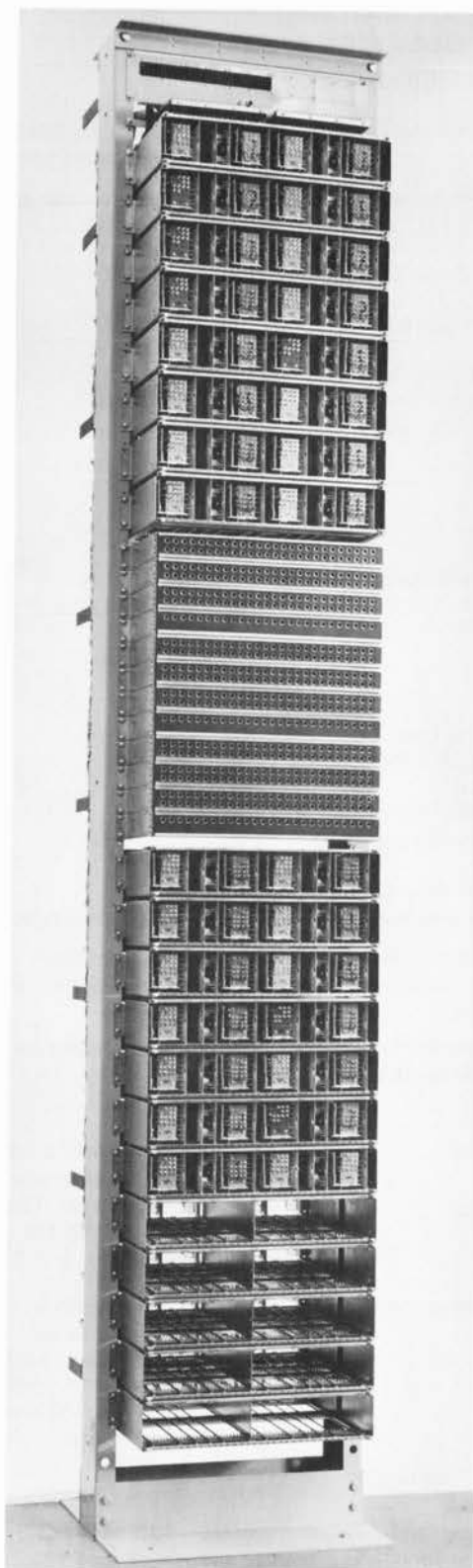
Voice-Frequency Repeaters, in their application to long subscriber lines or inter-office trunks, often eliminate completely a costly line revision; there are many installations where the entire investment in Stromberg-Carlson repeaters was appreciably less than the realized savings in outside plant cost made possible by their use.

#### Engineering Service

Stromberg-Carlson engineering service is available to help select the proper repeater to meet the requirements of an installation. When requesting this service, include a complete description of the facility and type of signaling used.

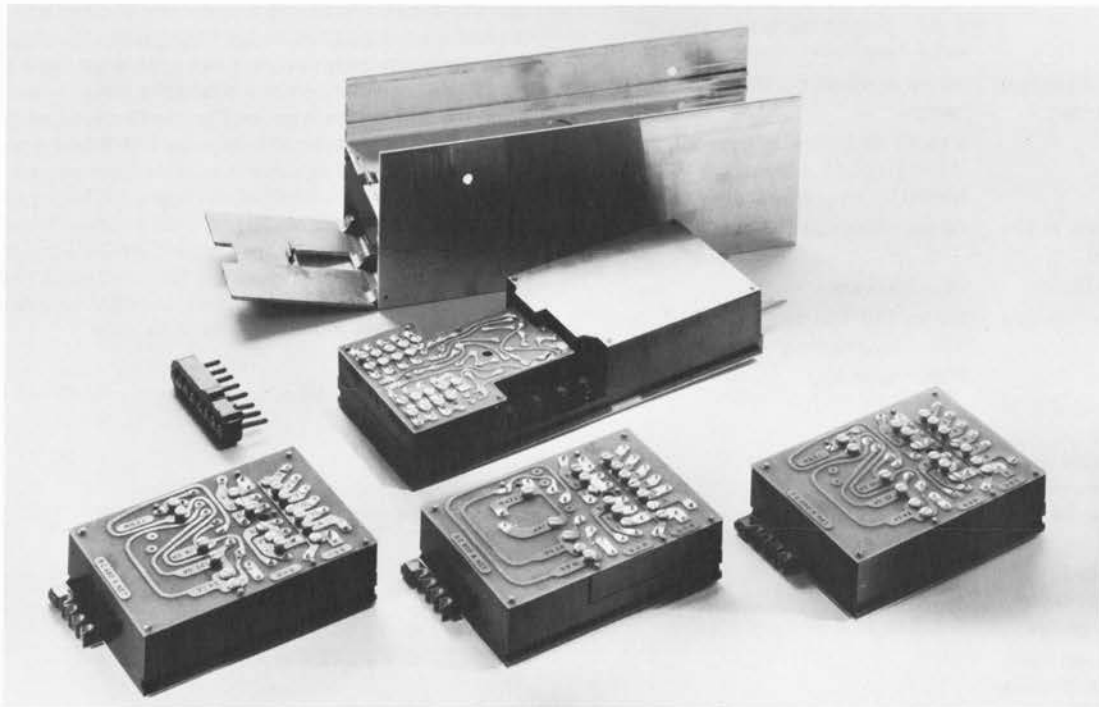


*S-C E6 Negative Resistance Repeater*



*Rack of 671 Hybrid Type Repeaters  
with Jack Field in Center of Bay*

## S-C E6 NEGATIVE-RESISTANCE VOICE-FREQUENCY REPEATER



*S-C E6 Repeater;  
components are selected as required*

The S-C E6 Negative-Resistance Repeater improves transmission on long trunk or subscriber lines. It can be used as an intermediate or terminal repeater, providing lower net loss circuits with higher return loss on cables. As an intermediate repeater it provides up to 12db gain, with the usable portion of this gain determined by the return loss of the line involved.

The S-C E6 is made up of a gain unit (converter), a selected line building-out network, and a compromise balancing network to match the central office. Then by simply tightening or loosening screws in the line building-out network, the impedance of the cable pair is brought to 900 ohms in series with 2 microfarads. Thus, the line is made to match the repeater.

### Application

The S-C E6 Repeater can be used with 19-, 22-, or 24-gauge D66 loaded high-capacitance cable; 19-, 22-, or 24-gauge H88 loaded high-capacitance cable; and 19-gauge H88 loaded low-capacitance cable.

Placement is governed primarily by the characteristics of the facility over which it is to operate, particularly length and uniformity of construction. In general, maximum gain is obtained if the repeater is placed at the electrical mid-point of the line, or at the junction between unlike sections of the line. If this method is followed, and no building exists at this place, a Stromberg-Carlson pole mounted repeater housing may be used. When a repeater is placed at one end of the line, the gain is reduced; repeaters placed at both ends of the line will normally provide the same maximum gain as a single repeater located at the optimum point.

When the S-C E6 is used as an intermediate repeater, two line building-out networks are required to match the impedance of the line sections on either side of the repeater location; when used as a terminal repeater, assuming that the required gain can be achieved in this manner, only one line building-out network is used.

### Design

The S-C E6 is composed of solid-state circuit elements employing printed cards and multiple adjusting screws. Each component of a repeater is individually removable from the housing; the complete plug-in unit is supported in a cell for rack mounting. Because both series and shunt elements are combined in one housing, and through other space-conserving refinements, up to 5 S-C E6 Repeaters can be mounted in 4 3/4" of vertical space on a 19-inch rack, and up to 6 repeaters on a 23-inch rack.

Line matching is achieved by a passive network that is separate from the gain unit. After the passive line building-out network has been adjusted by tightening or loosening screws, the gain can be varied in increments as small as 0.1 db over the full range of 1 to 12 db—again by a simple turning of screws on the printed card. It is thus easier to control crosstalk by the optimum setting for any particular cable pair.

Additional repeaters can be mounted in the cell at any time without any effect upon repeaters already in service. If desired, repeaters for future use may be stored in position and made active as needed.

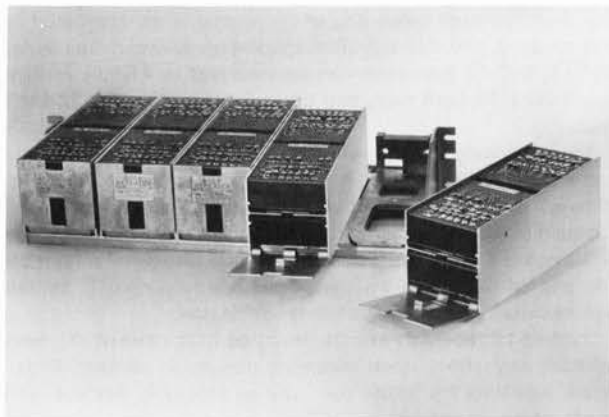
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## S-C E6 REPEATER

### Technical Specifications

Type	2-wire plug-in transistor operated, voice-frequency, negative-resistance.
Power Consumption, One Repeater	35 ma at 48-volt unfiltered CO battery.
Gain	1 to 12 db (screw adjustment).
Overload	+8vu output for speech; +16 dbm output for single-frequency power.
Direct current in line winding	60 ma maximum.
Frequency Range	300-3400 cps.
Temperature Ranges	0°F to 140°F in service; -40°F to 150°F for shipping and storage.
Humidity	95% maximum.
Networks suitable for line side:	
D66-loaded high capacitance cable 19, 22, or 24 gauge	S-C D66 LBO
H88-loaded low-capacitance cable 19 gauge	S-C 830B LBO
H88-loaded high-capacitance cable 19, 22, or 24 gauge	S-C 830A LBO
Network suitable for terminal side	S-C 832A Network
Space Requirements Repeater Cell Assembly	4 3/4 inch vertical mounting space; 19 inch width—mounts 5 repeaters; 23 inch width—mounts 6 repeaters.
Test Jack Assembly	1 3/4 inch vertical mounting space; 4 jacks per repeater.
Fuse and Alarm Panel	1 3/4 inch vertical mounting space; 19 or 23 inch width—mounts 13 fuses; 1 fuse per 12 repeaters.



## 541 AND 546 NEGATIVE-IMPEDANCE VOICE-FREQUENCY REPEATERS

The 541 Repeater is available as either a Series or a Shunt type; the 546 is a combination Series/Shunt in one housing. The 541 Repeater is extremely flexible; it will operate on either loaded or non-loaded cable and on mixed facilities. On non-loaded cable lines, the 541 Series type usually meets the application as a single unit. On loaded cable lines the 541 Shunt type and the Series Type are used *together* to provide optimum performance.

The 546 Repeater offers definite economic advantages when lines are of *high uniformity loaded H88 or D66*. When facilities meet this requirement, appreciable savings are possible in using the 546 Repeater. However for non-loaded lines, other loading schemes, or mixed facilities, the 541 Repeater with its more flexible built-in networks must be used.



Shelf of 8 Repeaters  
541 or 546 Type

### Technical Characteristics 541 and 546 Repeaters

Operating Frequency Range	250-3000 cps
Power Output Level	+10 dbm (MAX)
Total Harmonic Distortion in Per Cent (Series Repeaters)	

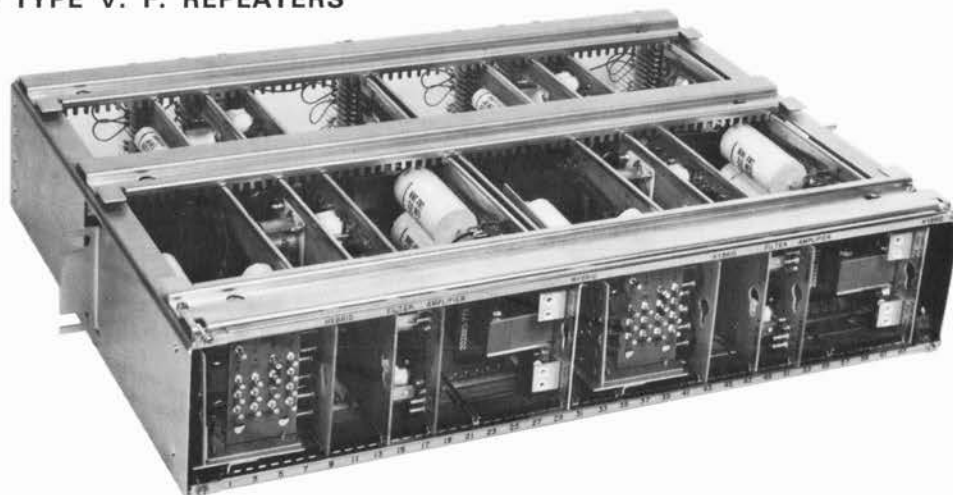
Power Output	6 db Gain	10 db Gain
0 dbm	1.4 %	1.9 %
+5 dbm	2.1 %	2.9 %
+10 dbm	2.6 %	4.0 %

Total Harmonic Distortion in Per Cent (Shunt Repeater)

Power Output	6 db Gain
0 dbm	0.032 %
+5 dbm	0.25 %
+10 dbm	1.1 %

Frequency Response Referred to 1000 cps (Series-Shunt)	+1 db, -3 db, 300-3000 cps
Maximum Nominal Gain	10 db
Noise Level (F1A Weighting)	Less than 15 dba
Operating Ambient Temperature	0°C to +55°C

## 671 HYBRID TYPE V. F. REPEATERS



Voice-frequency Repeaters of the hybrid type provide a substantial gain for circuits exhibiting a high transmission loss. The large gains required to bring such circuits up to toll standards are well within the capabilities of this type of repeater.

Offices differ in physical facilities which affect transmission losses. Hybrid repeaters—either terminal or through (intermediate)—have the latitude to handle these differences.

The Stromberg-Carlson 671 Repeater represents a major advance in applying solid-state circuitry and the card mounting of components to the hybrid type repeater. The flexibility obtained through the use of jack-in circuit cards permits tailoring the repeater to each particular use and line requirements. Initial cost is low and the use of transistors reduces power requirements and virtually eliminates maintenance. The only source of power required is the 48-volt or 24-volt central-office battery.

Modern in design with rack mounting cells and jack-in cards or modules. This method permits assembling circuit components on a card or module which is inserted vertically into the cell provided with grooved guides and jack-in circuit connectors at the rear of the cell. No bolting or soldering is required to install, remove or replace a card or module. The resultant economy of space permits mounting two complete, two-way repeaters in a single two space (3 1/2 inches high) cell on a standard 19-inch rack.

The Stromberg-Carlson 671 Repeater can be used as an intermediate or terminal repeater. Cards can be selected to provide various modes of operation; and the repeater gain, impedance and balance can be adjusted for any standard type of voice-frequency circuit. The 671 Repeater can be used on open-wire lines, also on 19, 22 or 24 gauge cable with various loading schemes or non-loaded cable to provide high-grade two-wire or four-wire circuits.

Coil hybrids are available for two-wire termination to match any central-office impedance. If required, A and B leads can be provided for trunk circuits thus eliminating external repeat coils. Cards are available to permit use of CX, DX, or SX signaling or to pass 20 cps, if required.

This repeater is capable of operating in any one of several modes and line-balance network cards are available to meet various requirements. Check your requirements.

### Operating Modes

Through Repeater, four-wire.  
Through Repeater, two-wire.  
Terminal Repeater, two-wire.  
Terminal Repeater, four-wire to two-wire.  
Phantom Through Repeater.  
Phantom Terminal Repeater.

### Performance Specifications

Type of Repeater	Hybrid.
Maximum Usable Repeater Gain	15 db.
Office Line Impedance	Below 465, 600, 900, above 1165 ohms
Trans-hybrid Loss	45 db or better with ideal termination.
Frequency Response	300 to 3,000 cps +1, -3 db.
Signaling Provisions	SX, DX, CX or 20 cps.
Equalization Compensation Adjustments	Provided for high and low frequency attenuation differences of line facility.
Power Requirements	48-volt or 24-volt central-office battery, at 104 ma max.
Operating Temperature Range	-40°F to +120°F.
Relative Humidity Range	Up to 95%.
Type of Amplifier	Transistor.
Amplifier Gain Adjustment	Slotted-shaft control.
A and B Lead Current	100 ma max.

NOTE: Specifications are subject to change due to Engineering studies.

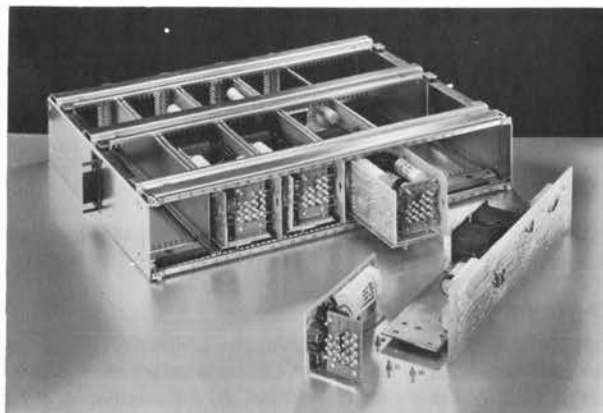
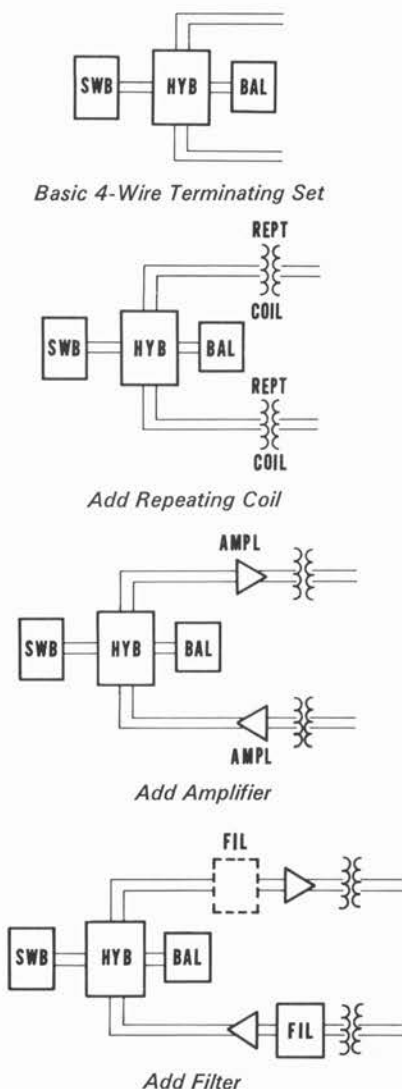
### Engineering Assistance

You are invited to take advantage of the assistance offered by our Field Engineering Services to help you select the 671 Repeater with available options to meet your particular requirement. When requesting this service, include a brief description of your facility and address your inquiry to the nearest Branch.

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### Building up from Basic 4-wire Terminating Set to 671 Repeater



4-Wire Terminating Set

### STROMBERG-CARLSON 4-WIRE TERMINATING SETS

Stromberg-Carlson 4-Wire Terminating Sets are ideal wherever it is necessary to make a transformation between 2-wire and 4-wire circuitry—whether physical or carrier/multiplex. The basic "set" is individualized to the facility and service being rendered; jack-in, modular component cards provide a selection of hybrid, precision balancing network, and standard cell for relay rack mounting. All three elements are identical to those used in the Stromberg-Carlson 671 Voice Frequency Hybrid Repeater. The Terminating Sets are available for a variety of line and drop impedances, achieving trans-hybrid losses of 45 db or better with ideal termination.

#### Typical Applications

A—Toll Connecting Trunks—In order to achieve the transmission objective of  $VNL + 2$  on trunks between Class 4 and Class 5 offices, it is becoming almost standard to derive these trunks on a 4-wire basis. Some means of 2-wire to 4-wire conversion becomes a requirement at each end.

B—Full Period Talk Circuits—There is an increasing demand for this type of special toll service for industrial and commercial subscribers. Normally 4-wire service is brought right in to the PBX and the conversion to 2-wire made by terminating sets located on the subscriber's premises.

C—Trunks to Foreign Exchanges—This application covers service from a local PBX directly over a toll link to a specific central office switchboard in some "foreign" exchange, with a 4-wire terminating set installed at the local PBX.

D—Voice Frequency Trunk Extensions—an application used between a 4-wire carrier or multiplex termination and a distant dial office employing 4-wire terminating sets at the carrier or multiplex terminal. Toll quality transmission can be attained over a combination of 4-wire and 2-wire facilities using a precision hybrid as an auxiliary network.

In these and other applications where it is advantageous to use 4-wire circuits, Stromberg-Carlson 4-Wire Terminating Sets provide the necessary flexibility—from basic 2- to 4-wire conversion to a full hybrid type repeater, with full equipment and signaling flexibility to match existing physical plant.

#### Brief Specifications:

Type of Terminating Set	2 Coil Hybrid
Office and Line Impedances	Below 465, 600, 900 and above 1165 ohms
Frequency Response	Essentially Flat 300-3500 C.P.S.
2-Wire—4-Wire Insertion Loss	4.5 db maximum
Trans-hybrid loss	45 db or better with ideal termination
A and B Signaling leads, current capacity	100 ma maximum
Balance Network	Internal compromise or precision, as required. Access provided for external network when required for special applications.



## 4-WIRE TERMINATING SETS

### Modular Concept . . .

#### Economy With Flexibility

Stromberg-Carlson 4-Wire Terminating Sets include the basic components shown immediately below; other components may be added as required. Matching is obtained first by selection, and then by strapping. If there is a subsequent major change in facilities, new conditions will be met by substitution of another jack-in hybrid card, or a different balancing network.

- Cell, fully pre-wired or less wiring
- Hybrid, to match nominal line impedance
- Precision Balancing Network as required

### Plug-In, Interchangeable Components: Ordering Information

### Mounting and Installation Data

Stromberg-Carlson 4-Wire Terminating equipment is mounted in same standard cell as the type 671 Voice Frequency Hybrid Repeater. In addition all component cards are completely interchangeable between the two. A cell occupies 3 ½ inches of vertical space on a 19 inch relay rack; five terminating sets can be accommodated in one cell.

When rack space is not available, a wall mounting box (with or without cover) may be ordered. This will hold up to three standard cells, with extra space for prints, tools or spares.

Cells and jack-in component cards use same contacts proved in service in all XY<sup>®</sup> Dial Systems. Balancing Networks are attached to the associated Hybrid card by only three screws and two wires so as to be changed easily if line structure is altered.

The 4-Wire Terminating Sets can be installed by your own employees; no electronic training is required. Easy-to-follow installation and balancing instructions are provided to guide the installer in external wiring and lineup procedures. No special test equipment is required.

		<i>Stock No.</i>	<i>Description</i>
<b>BASIC 4-WIRE TERMINATION</b>	<b>Hybrid</b>	438706-014	For Line Impedance below 465 ohms
		438706-024	For Line Impedance 465-780 ohms
		438706-034	For Line Impedance 780-1185 ohms
		438706-044	For Line Impedance above 1185 ohms
	<b>Balancing Networks</b>	202885-413	For 19H50 Cable
		202885-423	For 19H88 low capacity cable
		202885-433	For 19H88 and 22H88 high capacity cable
		202885-443	For 19H44 low capacity cable (side)
		202885-453	For 19H25 low capacity cable (phantom)
		202885-463	For .104 Copper-Steel 40 %, Open Wire
		202885-473	For .104 Copper, Open Wire
		202885-483	For 16, 19, 22 and 24 gauge non-loaded cable
		202897-773	For 19D66 and 22D66 high capacity cable
		202885-493	Compromise Network for special applications
<b>ADDITIONS AS REQUIRED</b>	<b>Repeating Coils</b>	<i>Stock No.</i>	<i>Description</i>
		438708-014	4-Wire, Voice Frequency, for Open Wire
		438708-024	4-Wire, Voice Frequency, for Loaded Cable
		438708-034	4-Wire, Voice Frequency, for Non-loaded Cable
	<b>Amplifier</b>	438705-016	Two Amplifiers, one in each direction
	<b>Filter</b>	202890-023	Low Pass Filter (1), 3KC one direction
		202890-013	Low Pass Filter (2), 3KC both directions
	<b>Equalizer</b>	202885-503	When required on Non-loaded Cable

## MULTIPLEX EQUIPMENT

Multiplex equipment applies the carrier principle to radio transmission; a means for increasing many times the communication paths available between terminals. Any telephone company bases its decision to use Multiplex on economic factors: the cost for this method of service compared to other methods such as full wire line, cable, or carrier.

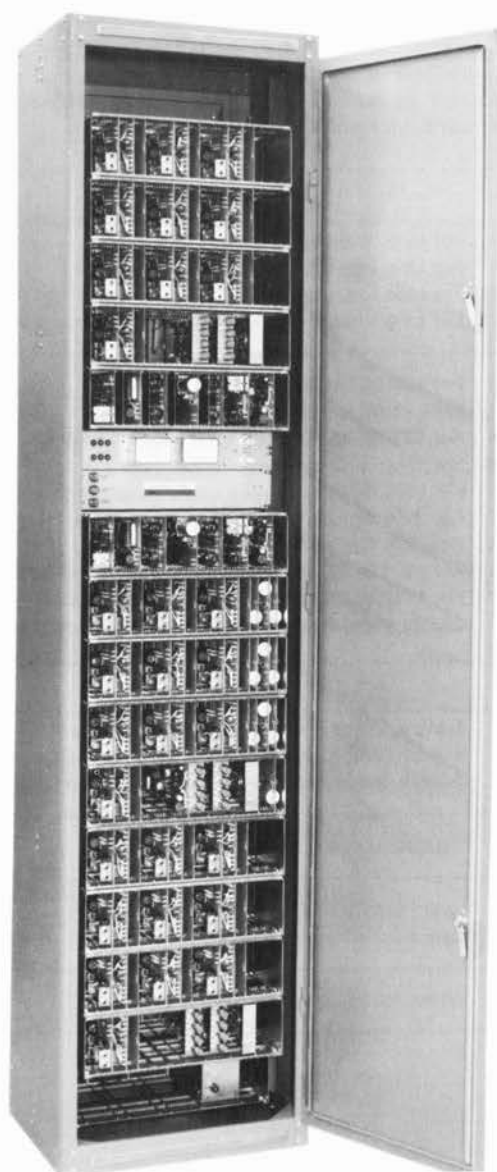
Radio-multiplexing does have certain inherent advantages:

1. It reduces circuit miles to the shortest possible route.
2. It spans rivers, large bodies of water, rugged terrain of any kind where cost of pole line is prohibitive.
3. Maintenance is limited to the terminal repeater locations.
4. It is easily expanded to almost unlimited capacity.

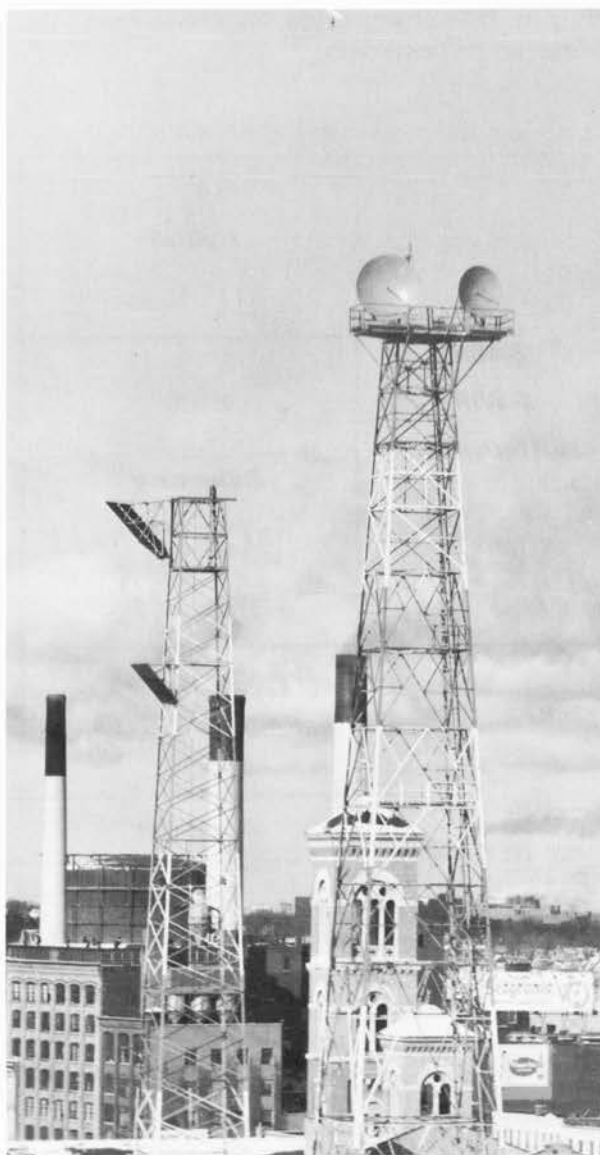
Many telephone companies that have high density traffic

between exchanges some distance apart, or interconnected by long wire line routes, have found it economically advantageous to carry long-haul through traffic via radio-multiplex, with drop-off at any intermediate point desired. The existing pole line circuits can then be used for extending short haul service from the central offices, and to intermediate points that have experienced rapid growth.

In addition to Multiplex, for converting voice frequencies to radio signals and back to voice frequencies, Stromberg-Carlson supplies radio equipment for this point-to-point transmission. These solid state, broad band microwave systems operate in the FCC-approved frequencies for Common Carrier, Industrial, and Government use.



*Rack of Multiplex Equipment*



*Telephone Microwave Equipment*

**STROMBERG-CARLSON**



## 711 CARRIER MULTIPLEX

Stromberg-Carlson 711 Carrier Multiplex equipment is designed to group as many as 240 separate telephone channels into a single composite signal for application to a broadband transmission path or microwave link. The use of solid-state techniques and plug-in circuit modules provides low-cost application to a broad variety of system arrangements.

The equipment may be connected to either 2-wire or 4-wire drop with standard V.F. levels.

The 711 Multiplex equipment may be ordered in a steel cabinet offering up to 30-channel capacity, or as rack mounted equipment of any capacity. The cabinet is 8 ft. high, 22 in. wide, and 20 3/4 in. deep. When equipment is mounted on standard 19 in. racks, a complete 10-channel group occupies 12 units or only 21 in. of vertical rack space. The optional 48-volt DC power supply operates on 115 volts, 60 cps, and occupies only an additional 3 units of rack space.

This equipment meets or exceeds EIA Standards.

### Features

**FLEXIBILITY**—Multiplexing makes possible the simultaneous transmission of numerous channels, each carrying voice or data signals, using a microwave radio channel to a distant point. This is accomplished by combining channels, each occupying a different frequency band. Simultaneous signal transmission is accomplished by modulating separate sub-carriers spaced at uniform intervals through the baseband frequency spectrum. This compound signal can be applied directly to microwave point-to-point radio, to transmit a combination of signals such as telephone, teletype, telemetering, facsimile and control signals.

**ECONOMY**—The equipment is designed for bridging each successive channel to the others until a basic group of 10 channels has been completed. Groups of 10 channels are combined into supergroups of 90 and 240 channel systems. The units employ frequency division, single sideband, suppressed carrier techniques for a more economical use of available RF frequencies. High frequency stability is assured through the use of crystal-controlled oscillators in temperature controlled ovens.

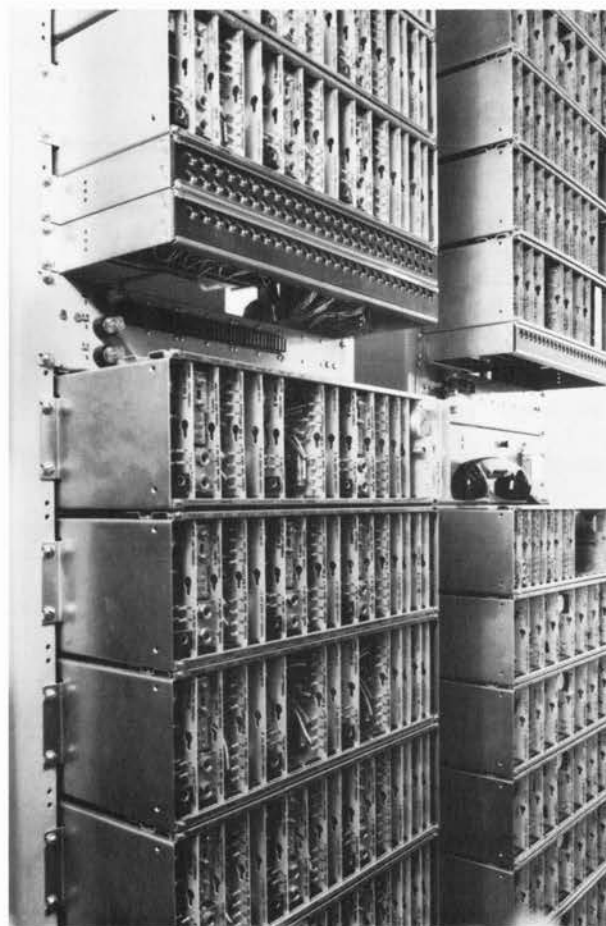
By suppressing the carrier, more economical use of power is achieved by using all the transmitted power for intelligence rather than dividing that power between the carrier and the intelligence.

The use of individual carrier oscillators for each channel frequency and the basic modulation plan chosen for the 711 Multiplex, make possible the economical installation of even a single channel, as well as the drop off of one of several channels at intermediate points in the system.

**RELIABILITY**—Through the use of transistors, diodes high grade capacitors and low loss, high-efficiency ferrite filter coils component failure is reduced thus system life is lengthened and maintenance minimized.

**EXPANSION**—The 711 Multiplex Equipment is designed to meet every requirement for efficient layout and expansion into larger groups of channels. With translators, the basic groups of 10 channels can be economically combined into larger groups to provide as many as 240 high-quality speech channels.

Modular units operate independently, permitting partially equipped systems to be expanded by adding new modules.



### Ease of Maintenance

Plug-in arrangement of the modules permits quick and easy replacement from the front of the rack. Card extenders are available for in-service testing; extenders permit maintaining electrical contact between the card and shelf connector while allowing access to both sides of an energized card.

### System Layout

The design of the 711 Multiplex Equipment lends itself to a most economical use of available space. Whether channeling equipment requirements are for many or a few channels and regardless of the office size and arrangement, the layout follows a standard pattern using the standard cable forms and bay arrangements. This method not only provides for ease of installation and maintenance, but also is advantageous in the event of future expansion in the system.

### Compatible with 511

The 711 Multiplex is compatible with the earlier Stromberg-Carlson 511 Multiplex. This older type, with many thousands of channel-miles in use, can be expanded at any time by ordering 711 Multiplex for additions.

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## 711 CARRIER MULTIPLEX

### System Technical Characteristics

Method of Transmission	Frequency division, single sideband, suppressed carrier.
Channel Bandwidth	300 to 3,000 cps.
Channel Frequency Response	+1 db -3 db with respect to 1,000 cps.
Baseband Impedance	Optional: 600 ohms; 135 ohms; 75 ohms. Balanced or unbalanced.
Voice Frequency Impedance	600 ohms $\pm 10\%$ , 2- or 4-wire.
Sideband Transmit Level	-25 dbm maximum; -50 dbm minimum.
Sideband Receive Level	-10 dbm maximum; -35 dbm minimum.
Signal Transmit Level	16 db (nominal) below Sideband Transmit Level.
Signaling	Out-of-band (3,400 cps); optional: tone on or tone off during seizure.
Signaling Options	E and M; ringdown; one-way loop.
VF Send Level, 4-wire	-16 dbm (minimum).
VF Receive Level, 4-wire	+7 dbm (maximum).
Carrier Oscillators	Crystal controlled; designed for external synchronization when desired.
Ambient Temperature Range	-20°C to 50°C.
Harmonic Distortion	Less than 3% at 1,000 cps.
Noise and Crosstalk (40% loaded)	Nominal 20 dba; maximum 26 dba.
Delay Distortion	500 microseconds, 900 to 2,900 cps.
Power Supply Requirements	48-volts dc; or 117-volts ac.

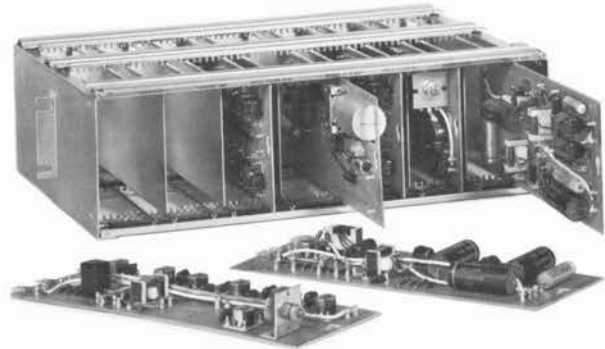
NOTE: Specifications are subject to change due to continuing engineering studies.

### Special Systems

Special arrangements of channeling equipment are available, when required to meet individual needs. The building block concept makes possible a wide variation of system configurations. All Stromberg-Carlson Multiplex Equipment combines extensive research with the invaluable experience gained from years of manufacturing and installing multiplex, carrier, and related communication equipment for a wide variety of users and uses.

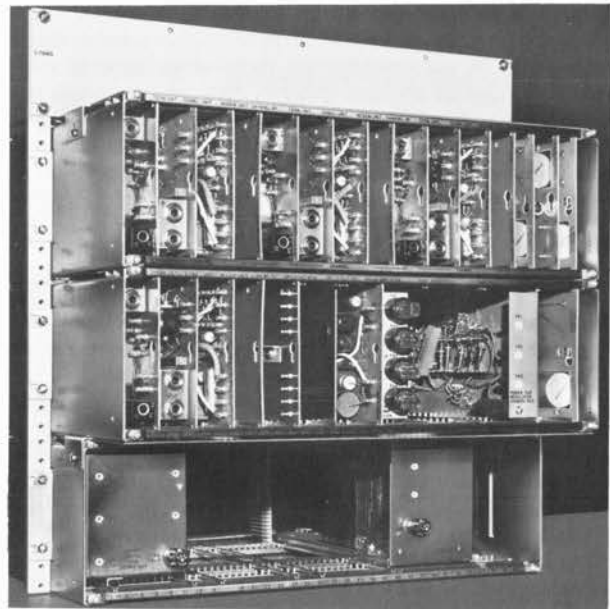
### Planning Assistance

Your Stromberg-Carlson Transmission Equipment Sales Representative can supply technical manuals that describe these carrier systems in detail, cover application considerations including line-loss calculations, and provide step-by-step installation instructions. An inquiry to our nearest branch office will receive immediate attention.



711 Cell and Components

### PRE-WIRED 4-CHANNEL 711 UNIT



Stromberg-Carlson 711 Multiplex Equipment is also available as a pre-wired four channel unit, specially packaged for quick installation, as an off-the-shelf product.

Employing standard 711 multiplex equipment with plug-in cards, this special assembly has all wiring brought to a terminal block at the top of the unit for ease in installation on standard 19-inch relay racks. No external signaling or hybrids are required.

The unit can be quickly installed in a relay rack to provide voice multiplexing or VHF control over regular microwave. It can be used to turn a remote transmitter on or off. One channel can be used as a service channel. The unit utilizes from one to four channels in the bandwidth from 4 kc to 44 kc. Completely stackable, channels can be added later as required to meet growth requirements.

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## AUXILIARY TRANSMISSION EQUIPMENT

### SIGNAL ADAPTER CIRCUITS (PULSE LINK REPEATER)

These circuits are used to connect E and M leads when Stromberg-Carlson Multiplex or Trunk Carrier is applied back-to-back with another make carrier on 4-wire basis. Mount on 19" rack.

	<i>Stock No.</i>
One Signal Adapter Circuit per plate	487050-000
Two Signal Adapter Circuits per plate	487051-000

### TERMINAL ADAPTERS

The following are carried as stock items:

		<i>Stock No.</i>
IP-1-CP	Single digit Dial Station Selector with tone generator for up to 10 stations	493868-000
IP-2-CP	Two digit Dial Station Selector with tone generator for up to 100 stations	492880-000
IP-11-CP	Dial line to carrier channel adapter, central office end, code ringing.	

<i>Impedance Ratio</i>		
<i>Trunk</i>	<i>Line</i>	<i>Stock No.</i>
900	900	411165-042
1300	900	411165-052
600	900	411165-062

IP-11-1-CP	Adapter for dial line to a 511 Type carrier channel control office end, code ringing.
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	<i>Stock No.</i>
1 circuit per plate	490236-000
2 circuits per plate	490237-000

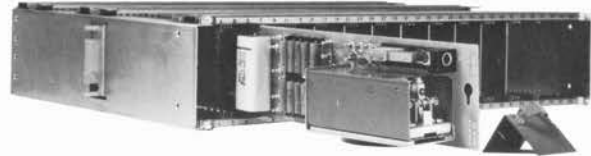
IP-12-CP	Dial line to carrier channel adapter, telephone end.
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<i>Impedance Ratio</i>		
<i>Trunk</i>	<i>Line</i>	<i>Stock No.</i>
900	900	411165-012
1350	900	411165-022
600	900	411165-032

IP-12-1-CP	Adapter for dial line to a 511 Type carrier, telephone end.
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	<i>Stock No.</i>
1 circuit per plate	490238-000
2 circuits per plate	490239-000

### DX SIGNALING



DX Signaling Circuits for 5,000 ohm maximum loops, assembled on the same type plug-in cards as used in 671 Type repeaters, are now available as off-the-shelf items. Seven of these DX Signaling Circuit cards can be mounted in one cell for 19" rack.

DX Repeating Coils are also available, mounted 2 per 671 Type card. Four of these cards can be inserted in one 19" cell.

This 19" double-wide cell can accommodate a combination of 5 DX Signaling Cards and 2 DX Repeating Coil Cards (4 Repeating Coils).

### STRAPPABLE ATTENUATORS

Two special purpose cards of the 671 Type for attenuation are available. One may be ordered with two strappable attenuators; the other, with a Type "H" configuration, provides one strappable attenuator and one amplifier for balancing. With these cards it is possible to strap in any required loss from ½ db up to 31 db.

### FUSE PANEL ASSEMBLIES

Easy-mount panels with fuse positions, mounting bars and screws; fuses as recommended.

	<i>Stock No.</i>
Panel, 3 fuse positions, with lamp	202710-252
Panel, 5 fuse positions	480308-000
Mounting Bar for above (2 per panel)	300346-613
Panel, 12 fuse positions	481789-000
Panel, 20 fuse positions	481791-000
Mounting Bar for above (2 per panel)	482399-000

### RELAY RACKS AND HARDWARE

Self-supporting 19" relay racks, in heights of 7', 8' and 9'; "XY" type relay racks in heights of 7', 9' and 11'-6". Terminal blocks of various capacities, mounting adapter plates, coax terminations, T-taps, mounting bars and grounding material (multiplex). Stromberg-Carlson can also supply other auxiliary equipment such as Tone Units, Power Supplies and Line Treatment Materials. Recommendation will be made for test equipment particularly suitable to the systems being placed in service.

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