Communications Control Group Assembly: Teletype Line Switching Equipment

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This article describes the teletype portion of the communications control group assembly installed in the GCF's deep space station communications equipment subsystem. The functions, developmental status, and operational features of the teletype switching equipment are discussed; and the necessity for interfacing with a variety of communications common carriers is explained.

I. Introduction

This article describes the teletype (TTY) line switching equipment which is a part of the communications control group assembly (CCGA) installed at each of the deep space stations. The CCGA is, in turn a part of the GCF's deep space station communications equipment subsystem (DCE). This teletype switching equipment functions as a component of the GCF teletype system as described in Space Programs Summary 37-66, Vol. II, pp. 111–113. This article considers the purpose, developmental status, and configurations of this teletype switching equipment.

II. Purpose of CCGA

The CCGA installed at each station interfaces with the communications common carrier who, with other carriers, provides the teletype transmission circuits between the stations and the SFOF. The station side of this teletype equipment is connected to the teletype machines and computers which generate and receive teletype data. The teletype switching equipment performs several functions:

(1) Accepts the widely varying teletype signals used by the various common carriers around the world and transforms these variable signals into a common logic level.

(2) Regenerates incoming teletype signal to reduce errors.

(3) Provides the switching necessary to distribute teletype signals to the various computers and teletype machines in the DSS.

(4) Provides standardized electrical levels to all of the equipment in the DSS.

(5) Provides, in some cases, the tone transmission equipment necessary for economical transmission of teletype signals over long distances between stations.

As noted, the various international communications common carriers (telephone companies) around the world utilize substantially different electrical interface levels for teletype transmission. The teletype switching equipment is specifically tailored to accommodate the interface used nationally at each station. Specifically the CCGA teletype equipment can accommodate the following external interfaces:

(1) Direct current; 60 mA neutral: the remote end supplies current on receive and transmit lines. (This is also the standard used with on-site equipment with CCGA supplying the current.)

(2) Direct current; 40 mA inverted polar: the CCGA supplies the transmit current.

(3) Direct current; 20 mA polar: the CCGA supplies the transmit current.

(4) Voice frequency shift keying. An audio carrier is shifted by the signal; used between DSS 11, DSS 14 and the Goldstone Area Communication Terminal (ACT), and between ACT and SFOF via microwave carrier.

III. Development and Status of the CCGA

Along with other systems and assemblies of the Ground Communications Facility, the CCGA has undergone evolutionary development. Development has been evolutionary because service must be maintained for current operations simultaneously with upgrading the overall facility to meet ever-increasing requirements for data volume and data rates. Multimission commitments of the DSN have dictated standardization of the communications configurations at all of the tracking stations. Operational standardization was achieved at all ten of the DSSs in 1969 when the CCGA equipment became operational.

The teletype portions of the CCGAs at the various stations are sized to meet the station needs. The size of the switching matrices, and other data, are shown in Table 1.

The CCGA is capable of expansion to ten external lines and twenty users, switched by matrix. The capability shown in Table 1 currently exists.

IV. Operational Features

The CCGA has the capability to terminate, regenerate, and distribute external teletype lines to on-site teletype machines and computers. The incoming and outgoing line signals conform to one of the four standards described previously. Internal routing and switching within the CCGA is in inverted-voltage mode and the interfaces to machines and computers at the station is standard 60 mA neutral.

Figure 1 shows the distribution of teletype signals performed by the CCGA. Two distribution paths are used:

A. Non-switched

Each of the computer teletype input and output ports and specific TTY machines are permanently connected through the CCGA to each of the external teletype lines. These computer ports and TTY circuit configurations can be rearranged only by patching.

Table 1. CCGA teletype input/output capabilities

DSS	Line access jacks	Line conditioning equipment	Receive matrix size		Transmit matrix size		Tone keyer shelves (6 lines each)
			Horizontal	Vertical	Horizontal	Vertical	
11	5	5	5 L	10 U[a]	10 U	5 L	1
12	6	10	10 L	10 U	10 U	10 L	0
14	6	10	10 L	10 U	10 U	10 L	2
21	5	5	5 L	10 U	10 U	5 L	1
41	5	10	10 L	10 U	10 U	10 L	0
42	7	10	10 L	20 U	20 U	10 L	0
51	10	10	10 L	10 U	10 U	10 L	0
61	6	10	10 L	10 L	10 U	10 L	0
62	6	10	10 L	10 L	10 U	10 L	0
71	5	10	10 L	20 L	20 U	10 L	0

[a]L = External line. Lines 6–10 on receive matrix are internally connected to lines 1–4 of transmit matrix.
U = Switched user (TTY machine).

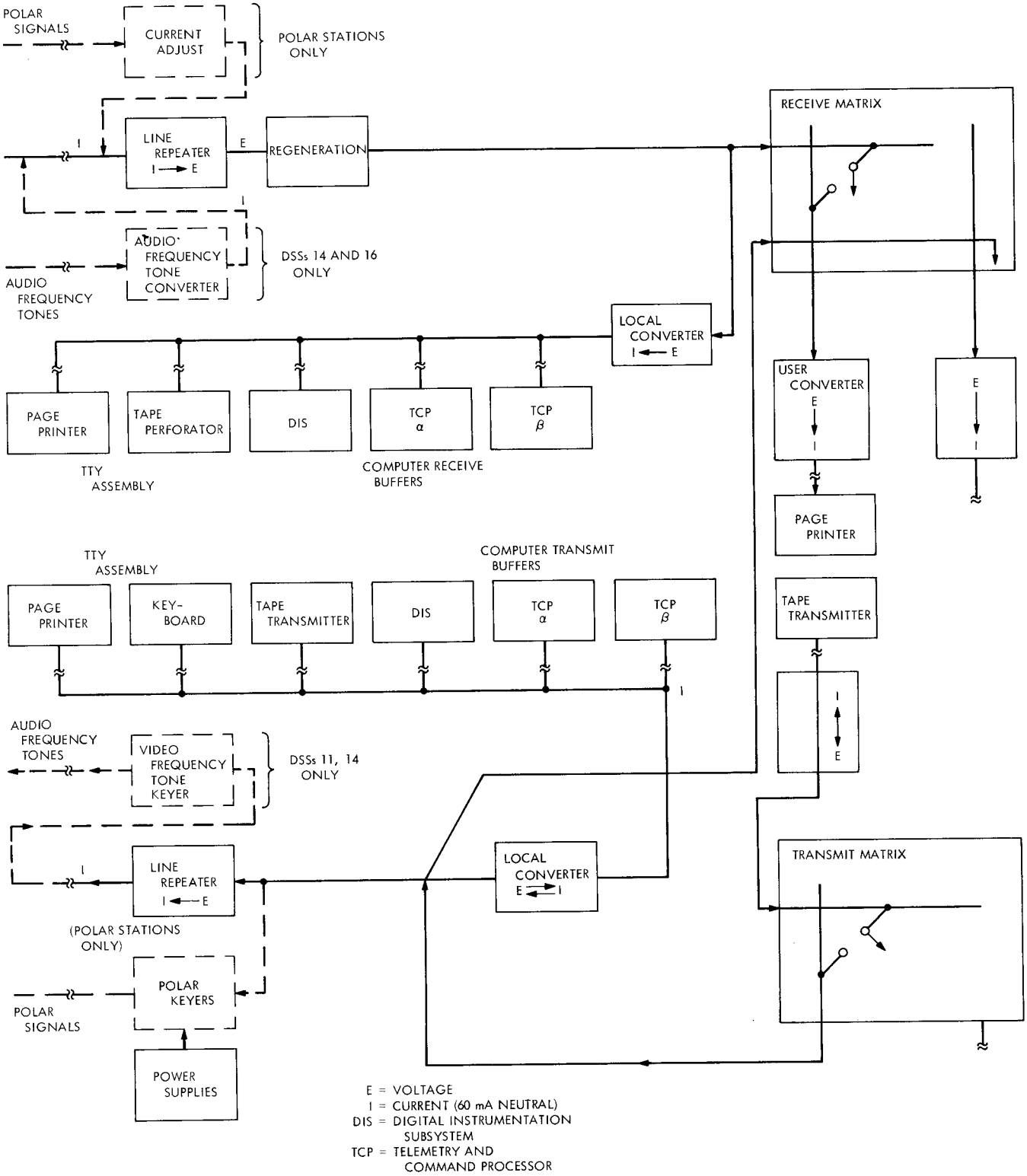

Fig. 1. Simplified signal flow

B. Matrix-switched

The incoming TTY signal is converted to a voltage mode signal and fed to the horizontal (X) of a receive matrix switch. Crosspoint switches route the signals to vertical (Y) outputs. These outputs are reconverted to 60 mA neutral and sent to user machines. The primary use of the receive matrix is to switch monitoring machines for the DSS control room. Conversely, in the opposite direction the TTY signals originating at the station are converted to voltage mode and then fed to a transmit matrix. The signals from the transmit matrix are converted to the appropriate station transmission standard and forwarded to the SFOF.

A complete monitoring and alarm system is incorporated into the CCGA. Flashing lamps indicate activity on the receive and transmit circuits; the matrix crosspoint switches are illuminated when a user line is selected.

V. Conclusion

The TTY CCGA is expected to provide a reliable means of controlling, conditioning, and distributing TTY signals at the DSSs.