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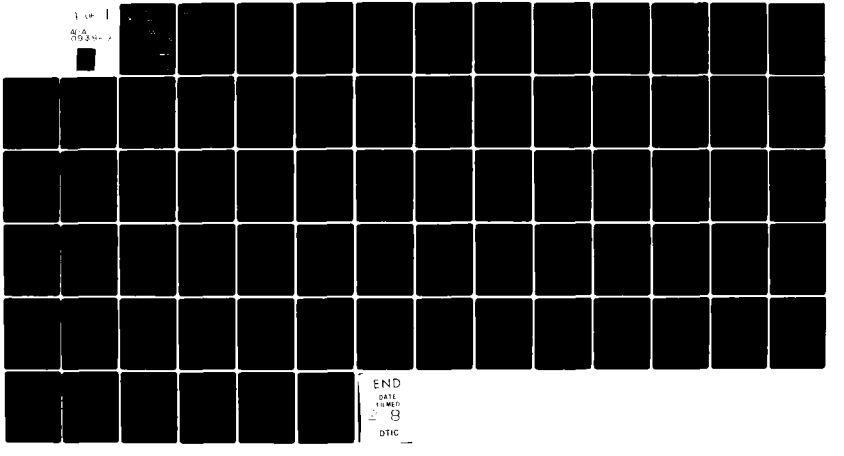

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DEFENSE COMMUNICATIONS AGENCY

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DCS OPERATING–MAINTENANCE ELECTRICAL PERFORMANCE STANDARDS

(11)
29 SEPTEMBER 1980
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*THIS CIRCULAR CANCELS DCAC 300-175-9, 20 DECEMBER 1970

DEFENSE COMMUNICATIONS AGENCY
WASHINGTON, D. C. 20305

DCA CIRCULAR 300-175-9*

29 September 1980

STANDARDS

DCS Operating-Maintenance Electrical Performance Standards

1. Purpose. This Circular specifies Technical Schedules and Standards necessary to operate and maintain Government-owned circuits at the expected level of performance for the Defense Communications System. This information is provided for use by circuit engineers and allocators in routing and activating new circuits and by O&M personnel in troubleshooting, testing, and correcting circuit deficiencies. The document also contains information on the availability and performance of leased circuits in the CONUS, tariff requirements, and commercial carrier performance objectives. In the case of leased circuits the information can be used in selecting commercial offerings for specific communication services, testing leased lines, and determining possible causes of trouble when service becomes unsatisfactory.

2. Applicability. This Circular applies to Headquarters, DCA; DCA field activities; the military departments; and other activities of the Department of Defense and Government agencies responsible for the operation and maintenance of the DCS.

3. References.

a. DCA Circular 310-70-1, DCS Technical Control, 29 March 1976, as amended.

b. DCA Circular 310-70-57, DCS Quality Assurance Program, 21 January 1974, as amended.

c. MIL-STD-188-100, Common Long Haul and Tactical Communication System Technical Standards, 15 November 1972, as amended.

d. MIL-STD-188-114, Electrical Characteristics of Digital Interface Circuits, 24 March 1976.

e. MIL-HDBK-414, Technical Control Facilities and Equipment for Long Haul Communications (undergoing final processing for publication).

Approved for public release; distribution unlimited.

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*This Circular cancels DCAC 300-175-9, 20 December 1977. (For summary of significant changes, see signature page.)
OPR: 1000
DISTRIBUTION: A, B, J through Q; Special

f. MIL-STD-188-346, Equipment Technical Design Standards for Analog End Instruments and Central Office Ancillary Devices, 30 November 1973.

4. Definitions. For other terms used in this Circular, see Federal Standard-1037, Glossary of Telecommunications Terms, July 1980.

a. DCS Operating-Maintenance Electrical Performance Standards. Those standards which establish the key electrical performance parameters that are used for the day-to-day operation and maintenance of the current DCS; that is, the DCS Technical Schedules, minimum performance standards for DCS links and multilinks, and operating power levels.

b. DCS Link and Multilink Channel Performance Standards. The specified maximum permissible change in the electrical performance parameters which are most indicative of specific link and multilink performance from or between technical control facilities or patch and test facilities, derived with reference to measured values of the same parameters made during a comprehensive alignment and maintenance overhaul or from official subsystem acceptance test documents.

c. End-to-End. The circuit from one user or terminal point on a private line service to the other user(s) or terminal point(s) on the same private line service as established by the requirement described in the Telecommunications Service Request (TSR), Telecommunications Service Order (TSO), Communications Service Authorization (CSA), Service Inquiry, or Order.

5. Policy. All operating and maintenance procedures employed in the DCS must be based on the preservation of maximum continuity of communications service of acceptable quality to all DCS users at all times. Accordingly, performance and maintenance tests or adjustments which require complete disruption of a service will not be scheduled regularly, but only as required by references 3a and 3b. Such tests will be repeated only when there is a clear indication from in-service measurements of selected key parameters that there has been a significant degradation in performance below established thresholds for that particular service. The automatic switching centers of the DCS have been designed, instrumented, and built around a maintenance concept compatible with this policy.

6. Scope. This Circular is limited to establishing circuit and link performance standards. The application of these standards in quality control, quality assurance, or other programs is covered in other Circulars and is beyond the scope of this document.

7. The DCS Technical Schedules.

a. Use.

(1) The Technical Schedules provide a common language for DCS circuit ordering, allocation, activation, operation, and maintenance.

They serve two primary purposes: The service description tables provide a guide for the circuit allocator/engineer to identify standard circuit performance parameters typically used to support a particular service; the circuit parameter tables provide the allocator/engineer a shorthand method of specifying quality control circuit parameters in the TSO without having to spell out the details of the required performance.

(2) In some cases, particularly with circuits which traverse both military and commercial paths or paths of more than one carrier, the allocator/engineer will not be able to apply the tables for end-to-end circuit performance measurements. In these cases, he will be required to specify, in the TSO, the details of the required end-to-end circuit performance as well as the schedules to be applied to the individual commercial and military circuit portions.

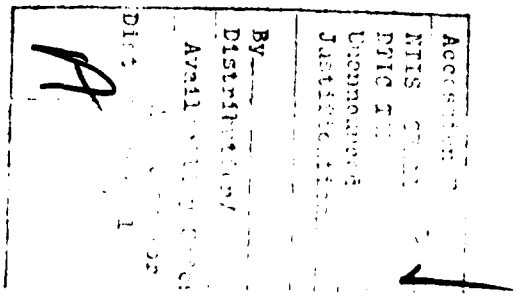
(3) MIL-STD-188-100 provides the overall requirements of end-to-end circuit performance for military telecommunications. It is these requirements upon which the Technical Schedules are based. Occasionally, because of obsolete equipment used in the DCS, it may not be possible to meet the requirements of MIL-STD-188-100. Similarly, some service will require more stringent performance than that specified in the MIL-STD. In all cases, the performance parameters which a circuit is required to meet will be specified in the TSO. Standards for the interface of digital circuits are contained in MIL-STD-188-114.

b. Government-owned circuits. The DCS Technical Schedules for Government-owned circuits are provided in enclosure 1, tables 1 and 2. Table 1 provides an itemized description of the common services in the DCS with the exception of voice circuits over high-frequency radio systems. Table 2 provides circuit parameters for each type of circuit described in table 1. The minimum DCS circuit performance as measured end to end will equal or be better than the numerical values specified in the Technical Schedules.

c. Leased Circuits. The DCS Technical Schedules for leased circuits are provided in enclosure 2. The contents of enclosure 2 are as follows:

(1) CONUS. The DCS Technical Schedules for circuits leased in the continental United States (CONUS) are provided in tables 1 through 7 of enclosure 2.

(a) Table 1. Table 1 applies to circuits leased from AT&T. The table is similar to table 1, enclosure 1, for Government-owned circuits except that AT&T has prepared an additional column which shows the currently applicable FCC tariff and channel type and the conditioning that AT&T recommends to meet each DCS service described in the table. This column relates to the Description of DCS Service rather than to the DCS Circuit Parameter Code and will not always correlate with the parameter code. In some cases the Bell System circuit conditioning recommended is less stringent than that for Government-owned systems. However, AT&T assures DCA that the Bell System circuit conditioning recommended will yield proper operation provided



that Bell System data sets are used where indicated.[1] If other vendors' data sets are used, the contracting commercial carrier will be requested to condition the line to meet the data set line specifications in the TSO.

(b) Tables 2 and 3. Two tables containing Bell System technical parameters for voice bandwidth circuits have been extracted from Bell System Technical Reference Publication 41004 and are included as tables 2 and 3 for ease of reference.

(c) Tables 4, 5, and 6. Three tables containing Bell System technical parameters for wideband secure voice circuits have been extracted from various Bell System Practices (BSP's) and are included as tables 4, 5, and 6 for ease of reference. These tables summarize the commercial secure voice technical schedules which are designated by AT&T as G-1, G-2, and G-3.

(d) Table 7. Table 7 applies to circuits that are leased from Western Union. This table is similar to table 1 of enclosure 1 except that Western Union has prepared an additional column which shows the applicable FCC tariff and channel type and the conditioning that Western Union recommends to meet each DCS service described in the table. This column relates to the Description of DCS Service rather than to the DCS Circuit Parameter Code and will not always correlate with the parameter code. In some cases the Western Union circuit conditioning recommended is less stringent than that for Government-owned systems. However, Western Union assures DCA that the Western Union circuit conditioning recommended will yield proper operation provided that Western Union data sets are used where applicable. If other vendors' data sets are used, the contracting commercial carrier will be requested to condition the line to meet the data set line specifications in the TSO. For those cases where Western Union has no comparable general channel offering but has furnished a similar service, the 9000 series channel has been used. The 9000 series is a special arrangement which can be ordered between specified locations.

(e) Commercial Reference Documents. Reference is made in table 1 to various AT&T documents which provide pertinent technical and operating information on the various public service offerings of the Bell System. Ordering information for these documents is provided in enclosure 2, page 1.

(f) Application to CONUS Leased Circuits. Numerous U.S. commercial carriers concur with the AT&T tariff (FCC 260). Since AT&T, Western Union, and the concurring carriers represent the vast majority of carriers from which CONUS DCS circuits are leased, tables 1 through 7 will apply to most circuits leased in the CONUS.

(2) International.

(a) U.S. International Carriers (USIC's). Tables 1 and 2, enclosure 1 for Government-owned circuits also apply in general to circuits leased from USIC's. Commercial carriers identified as USIC's include American Telephone and Telegraph Company Long Lines, FTC Communications, Inc., ITT World Communications, Inc., RCA Global Communications, Inc., TRT Telecommunications Corporation, and Western Union International, Inc.

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[1] See footnote 23, enclosure 2, table 1, page 13.

(b) Other International Circuits (to be developed).

(3) Foreign National Circuits (to be developed).

8. DCS Link and Multilink Channel Performance Standards.

a. These standards apply to Government-owned systems and provide criteria by which both the military departments and DCA can gauge how well new and old equipment, facilities, or systems are maintained and operated. As indicated in paragraph 4b, these standards apply to link and multilink performance (technical control to technical control) in contrast to the Technical Schedules which apply to circuits (end to end).

b. In view of the nonuniform performance over many different DCS link and multilink configurations, even with optimum transmission adjustment, performance parameters should be determined individually for each DCS link and multilink. To this end table 1, enclosure 3, specifies the permissible deviation from the performance levels for each of the pertinent parameters, established and derived from the results obtained for each link or multilink during either the test and acceptance (T&A) of the facilities for operational use, subsequent major upgrade and realignment of the facilities, or DCS Technical Evaluation Program. If performance data are not available, then table 2, enclosure 3, applies. Table 2 provides performance parameter values which may be used pending the availability of measured performance data.

c. Measurements that fail to meet the performance limits will be made the subject of continuing attention by the military departments until the fault has been corrected. No special action is required by DCA, but significant data will be made available to the military departments and DCA performance evaluation teams. All reports required under other directives will continue and may include these data if appropriate.

9. Transmission Levels.

a. Voice Signal Levels. Voice signals are generated by human speech and hence present a constantly fluctuating power level. Variations up to 20 dB are common and are caused by such factors as the differences in emotional content of the speech, talker volume, background noise, telephone subset efficiency, microphone battery current, and net loss of the subscriber loop. Since power levels vary widely, circuit adjustments should never be made on the basis of voice signal power levels. All communications circuits used in the DCS should be carefully engineered and adjusted prior to operation. Circuit net losses should be measured with a single frequency test tone.

(1) Voice Signal Levels Within the DCS. Voice signal levels within the DCS should not exceed 1.74 peak volts at a 600 ohm 0 TLP. Facilities operating at higher levels will be equipped with the DCS standard passive peak limiter described in MIL-HDBK-414.

(2) Voice Signal Levels at Non-DCS Interfaces. Voice signal power levels to and from non-DCS facilities should be adjusted by inserting appropriate net losses or gains at facility interfaces to effect system

compatibility. The DCS should be protected from signals exceeding 1.74 peak volts at a 600 ohm 0 TLP by the DCS standard passive peak limiter described in MIL-HDBK-414. TLP's of tactical systems may not be based on the same reference as those of long haul systems. Stations should comply with circuit engineering details provided in TSO's. Typical DCS/Non-DCS interfaces are provided in figures 4.7-8, 4.7-9, and 4.7-10, MIL-STD-188-100.

b. Test Tone Power Levels and Frequency. The test tone power levels and test frequency to be used when testing Government-owned communications circuits, links, equipment, etc., in the DCS will be as specified herein.

(1) Standard Test Tone Frequency. The standard test tone frequency for testing Government-owned DCS voice frequency circuits will be 1004 Hz for items annotated with an asterisk (*) in paragraph 9b(3). The reference frequency for item (b) will also be 1004 Hz. A 704 Hz test tone applies to item (i).

(2) Expression of Power Levels.

(a) At various points in a transmission system, signal power should be at levels determined by system design. The design power levels at these transmission level points (TLP's) are expressed in relationship to a reference point which is defined as the 0 TLP. The transmission level of any point in a transmission system is the ratio (in dB) of the power of a signal at that point to the power of the same signal at the reference point.

(b) In the DCS, TLP's are established such as 0(dB)TLP, -8(dB)TLP, -16(dB)TLP, etc., normally expressed as *0 TLP, -8 TLP, -16 TLP*. Thus, a 0 dBm (1mw) signal entered at a 0 TLP should appear as a -8 dbm signal at the -8 TLP. In this Circular, power levels are expressed in dBm0; i.e., the power level expressed in terms of its relationship to the 0 TLP. For example, the standard test tone level in the DCS is -10 dBm0. At the 0 TLP, the absolute power level would be -10 dBm; i.e., 10 dB below the TLP. At -16 TLP the test tone level would be -26 dBm. Therefore, a test tone of -26 dBm would be applied at the -16 TLP.

(3) Standard Test Tone Power Level. The standard test tone power level for testing Government-owned DCS circuits will be -10 dBm0. Tests using this tone should be performed as required to ensure circuit quality. The standard test tone level is used for the following measurements:

* (a) Net loss

(b) Frequency response

(c) Envelope delay

(d) Terminal impedance

* (e) Gain hits

* (f) Phase jitter

* (g) Net loss variation

* (h) Signal-to-noise

(i) Harmonic distortion

* (j) Phase hits

* (k) Drop outs

* (l) Signal-to-C-notched noise

(m) Nonlinear distortion

(4) Nonstandard Test Tone Power Levels. The use of test tone power levels higher than the standard level is permissible to measure parameters that are level sensitive such as harmonic distortion or intermodulation noise at high levels. Such tests are permitted only during nonbusy hours or on systems which are out of service. Test signal power levels greater than 0 dBm0 will not be applied to operational channel systems under any circumstances.

(5) Monitor Test Tone Power Level. The standard monitor test tone power level to be used on voice frequency type DCS facilities when testing on an indefinite basis will be -15 dBm0.

c. Composite Data Signal Power Levels. Composite data signal power levels for operation over communications circuits, links, equipment, etc. in the DCS will be as specified herein. These include all tone signals (including modulation products) used to transmit data information over DCS voice frequency channels, whether the signal is a single tone or multiple tones, or whether the information is record traffic, computer-to-computer, or secure voice communications.

(1) Standard Composite Data Signal Power Level. The standard composite data signal power level for operation in the DCS will be -13 dBm0.

(2) Nonstandard Composite Data Signal Power Levels. The use of data signal power levels higher than the standard level is permitted only over DCS facilities involving FDM basebands and radio systems which are out of service and when it has been clearly determined by proper authority that such levels will not interfere with other communications systems. Higher levels are permitted over circuits derived completely from PCM systems, since hard-limiting devices form an integral part of the input circuitry to such systems to prevent overload of the coder circuitry. The use of data signal levels lower than the standard is permissible by special agreement with operating elements.

(3) Commercial Interface Composite Data Signal Power Levels. The data level at the interface point of DCS and commercial facilities must be such that both systems are compatible. To this end there must be a clear agreement between the leasing authorities (for the DCS and the commercial

carriers) as to specific interface levels at the time of the lease. The preferred composite data level at such points interfacing DCS Technical Control Facilities is -13 dBm in both directions of transmission. The preferred data level at such points interfacing data users of the CONUS AUTOVON is 0 dBm transmit and -16 dBm receive. The data level at other user interface points will usually be specified by the commercial carrier.

d. Telephone Signaling Tone Power Levels. Telephone signaling tone power levels for operations over communications circuits, links, equipment, etc., in the DCS will be as specified herein. These include single frequency (SF) tones, dial tones, ringback tones, preempt tones, busy tones, various other supervisory tones, dual-tone multifrequency (DTMF) signals, and multifrequency (MF) signals. (See enclosure 5.)

(1) Standard AUTOVON Telephone Signaling Tone Power Levels. Standard signaling and supervisory tone power levels for operation of AUTOVON in the DCS are specified in table 1, enclosure 5.

(2) Standard Telephone Signaling Tone Power Levels. Standard telephone signaling and supervisory tone power levels for all other services provided by the DCS and not covered previously are specified in tables 2 and 3, enclosure 5, and paragraph 4.3.1.1, MIL-STD-188-346.

(3) Nonstandard Telephone Signaling Tone Power Levels. Signaling and supervisory signals (including signaling impulses) interfacing the DCS from commercial or non-DCS facilities should comply with the levels in paragrapn 5.3.1.2, MIL-STD-188-346. If interfacing signaling tones and associated impulses exceed 1.74 peak volts at the Government's 600 ohm 0 TLP, passive peak limiters as described in MIL-HDBK-414 will be installed to protect the DCS facilities.

e. Test Procedures. Test procedures and schedules specified for measuring the electrical parameters of DCS circuits are published in DCA Circular 310-70-1, DCS Technical Control, Volume II, Procedures, as amended.

10. Bit Error Rate Performance. Digital parameters for data service are under development. Until these parameters are established, the following interim guidance is provided. The average data bit error rate performance of 1200 through 9600 bits per second, derived from dedicated voice frequency circuits on an end-to-end basis over the Government operated and maintained portion of the DCS, should equal or be better than 1×10^{-5} over any 10^{6} bit interval 99 percent of the time. The bit error rate for circuits

operating at 1.544 Mb/s, described in table 1, enclosure 1, will be as specified in table 2, enclosure 1.

FOR THE DIRECTOR:

OFFICIAL:

R. B. EVANS
Captain, USN
Chief of Staff

VINCENT R. VOLONOSKI
Chief, Administrative Support Division

6 Enclosures

1 DCS Technical Schedules for Government-Owned Facilities
2 DCS Technical Schedules for Circuits Leased in CONUS
3 DCS Link and Multilink Channel Performance Standards
4 Noise Power Conversion Table
5 Standard Telephone Signaling Tone Power Levels

SUMMARY OF SIGNIFICANT CHANGES. This revision redefines the term "Operating-Maintenance Electrical Performance Standards" to encompass all standards included in this Circular. This term previously applied to link and multilink standards which are now defined under the term "DCS Link and Multilink Channel Performance Standards." Also, this revision provides DCS Technical Schedules for circuits leased in the CONUS; specifies voltage levels instead of volume units for measuring voice signals; and includes major changes to the "X" and "Z" Schedules.

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	Technical Schedules pertinent to services not mentioned herein will be developed on a case-by-case basis as requests for these services are received by the responsible DCA Circuit Allocation and Engineering Organization. When warranted by the degree of usage, an appropriate Technical Schedule for the particular service will be published by DCA.	
	CATEGORY 1: USER-TO-USER CIRCUITS	
	VOICE	
1A	Nonsecure voice circuit.	V1
1B	Secure voice, operating at 2400 baud.	S1
1C	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to transmission over metallic facilities without regenerators.	Z1
1D	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to long-distance transmission over radio systems.	Z4
1E	Alternate voice/record, including secure voice or data, operating at rates from 2400 b/s up to 9600 b/s. Circuit parameter code S3 is not available for user-to-user service but was developed to permit interconnection of up to five tandem S3 links and still obtain S1 circuit performance on an end-to-end basis.	S1

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 1: USER-TO-USER CIRCUITS (CON.)	
	FACSIMILE	
1F	Facsimile transmission which can be accommodated over a voice grade channel with no special conditioning. If the required facsimile (including telephoto) service involves special conditioning of the channel, specific circuit parameters will be based on transmission means, circuit length, and characteristics of the equipment used to terminate the circuits.	V1
	TELEGRAPH AND DATA	
1G	Less than 46 baud. Includes 60 wpm teletypewriter and other d.c. keying service.	N1
1H	46 through 75 baud. Includes 75 wpm and 100 wpm teletypewriter and other d.c. keying service.	N2
1J	76 through 150 baud. Includes 110 baud teletypewriter and other d.c. keying service.	N3
1K	Less than 46 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1
1L	46 through 75 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1
1M	76 through 150 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1
1N	066-068 IBM transceivers (10 to 40 cpm).	V1

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	TELEGRAPH AND DATA (CON.)	
1P	300 through 600 baud. Includes data card or other service.	D2
1Q	1200 baud. Includes data card or other service.	D2
1R	2400 b/s; alternate voice/record service.	S1
1S	4800 b/s; alternate voice/record service.	S1
1T	9600 and 7200 b/s; alternate voice record service.	S1
	CATEGORY 2: VOICE FREQUENCY	
	CARRIER TELEGRAPH (VFCT) SYSTEMS	
2A	VFCT, type 1. Up to 16 telegraph channels.	D2
2B	VFCT, type 2. Up to 26 telegraph channels provided over a voice frequency channel between carrier terminals.	S1[1]

[1]Circuit parameters for S1 apply except the maximum change in audiofrequency is limited to ± 2 Hz instead of ± 5 Hz.

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 3: AUTOVON ACCESS LINES	
3A	Voice grade.	V2
3B	Special grade, alternate voice/record access from AUTODIN switch, and 2400 through 9600 b/s secure voice access from secure voice terminals, cordboard (SECORD), SEVAC, and other secure four-wire switchboards.	S3
3C	Special grade, alternate voice/record.	S3
	CATEGORY 4: AUTOVON TRUNKS	
4A	Interswitch voice grade.	V2
4B	Interswitch special grade, not transoceanic (no regenerators at either end).	S3
4C	Interswitch special grade, not transoceanic (regenerators at both ends).	S1
4D	Interswitch special grade, not transoceanic (regenerators at one end).	S2
4E	Interswitch special grade, alternate voice/record.	S3
4F	Loop-around, regenerative, Option 1. Regenerators located physically at the AUTOVON Switching Center.	S3
4G	Loop-around, regenerative, Option 2. Regenerators located physically at a remote site on Government property.	S3

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 5: AUTODIN ACCESS LINES	
5A	75 baud; d.c. keying.	N2
5B	150 baud; d.c. keying.	N3
5C	75 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2
5D	150 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2
5E	300 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2
5F	600 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2
5G	1200 baud; limited to data service only.	D2
5H	1200 b/s multiplexed; from a user or transmission nodal point where a VF channel is multiplexed or bridged with any compatible combination of 75-, 150-, 300-, or 600-baud modems not to exceed 1200 b/s total. VF bridging is used at transmission nodal points to serve noncollocated users.	D2
5I	Not used.	
5J	2400 b/s; alternate voice record service.	S1
5K	Not used.	
5L	Not used.	

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 5: AUTODIN ACCESS LINES (CON.)	
5M	4800 b/s; alternate voice/record service.	S1
5N	Not used.	
5O	Not used.	
5P	Not used.	
5Q	9600 and 7200 b/s; alternate voice record data service.	S1
	CATEGORY 6: AUTODIN INTERSWITCH TRUNKS	
6A	2400 b/s through 4800 b/s; dedicated circuit from one AUTODIN switch to another.	S1
6B	Not used.	
6C	9600 and 7200 b/s; alternate voice/record service.	S1
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES	
7A	Not used.	
7B	Secure voice terminal, 2400 b/s, to four-wire JOSS or AUTOVON switch.	S3
7C	Secure voice terminal, 50 kb/s baseband, to SECORD or AUTOSEVOCOM switching facility without regenerators over metallic facilities.	Z2

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES (CON.)	
7D	Secure voice terminal, 50 kb/s baseband, to special 758 switch or cordboard (SECORD) or AN/FTC-31 over long-distance carrier facilities.	Z4
7E	Secure voice terminal, 50 k/s baseband to AN/FTC-31, over metallic facilities.	Z2
7F	Secure voice terminal, operating at 9600 b/s to JOSS or AUTOVON switch.	S3
	CATEGORY 8: AUTOSEVOCOM TRUNKS	
8A	50 kb/s baseband, over metallic facilities without regenerators.	Z3
8B	50 Kb/s baseband, over long-distance carrier facilities.	Z4
8C	Not used.	
8D	2400 b/s (JOSS to either a JOSS or a cordboard (SECORD)).	S3
8E	2400 b/s (SEVAC to JOSS or 5-D switchboard).	S3
8F	Interswitch trunk operating at 2400 or 9600 b/s providing secure voice service. (This service is derived from the AUTOVON.)	S1

TABLE 1. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

ITEM NUMBER	DESCRIPTION OF DCS SERVICE	CIRCUIT PARAMETER CODE
	CATEGORY 9: 60-108 kHz BASIC GROUPS	
9A	Frequency Division Multiplexing (FDM) Use. This item should be specified whenever a DCS 60-108 kHz channel is equipped with GFE FDM equipment at DCS station locations.	X1
9B	Derivation of 50 kb/s Data Service. This item should be specified whenever a 60-108 kHz channel is required to interconnect 50 kb/s points in the DCS by use of a special GFE modem and GFE auxiliary set (such as WECO type 303 data modem and WECO type 842 data auxiliary set which provides interconnection of subscribers on a 4-kHz basis whenever the 50 kb/s signal is removed from the user's 4-wire line.) The derived service is similar to item 7D. The AN/USC-26 group data modem may also be used in deriving this service, but in the half group mode of operation the data signal level (Circuit Parameter Code X2, item k, table 2) should be reduced to -8 dBm0.	X2
	CATEGORY 10: 1.544 Mb/s BASIC DIGROUPS	
10A	Time Division Multiplexing (TDM) Use. This should be specified whenever a 1.544 Mb/s circuit is equipped with PCM equipment at DCS station locations. Generally used to derive 24 voice channels, but data channels may also be derived.	Y1(3)

[3] See footnote 23 in enclosure 2, table 1, page 13.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS

CIRCUIT PARAMETERS

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
a. Frequency Response[1] kHz	dB								
0.3-2.7								-2 to +6	
0.3-3.0		-2 to +6	-1.5 +4.5	-1 to +3		-3 to +8	-2 to +6	-3 to +12	
0.4-2.8					-8 to +20				
0.5-2.8		-1 to +3	-0.5 to +2	-0.5 to +1.5			-1 to +3		
0.6-2.4					-7 to +12				
1.0-2.4								-1 to +3	
0.7-2.3						-1 to +3			

[1]Loss frequency characteristics are given in terms of comparison to the measured loss at 1004 hertz. For example, in the S1 schedule the loss frequency characteristic should not exceed the range of 2 dB less loss (-) to 6 dB more loss (+) between 0.3-3.0 kHz when compared to the measured loss at 1004 hertz. This frequency is used to avoid subharmonics of the 8 kHz frequency used extensively in PCM/TDM.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
b. Maximum Envelope Delay variation allowable in each specified band	micro-sec								
kHz									
0.5-2.8		3000	1500	600			3000		
0.6-2.6		1500	750	300			1500		
0.8-2.6								1750	
1.0-2.4								1000	
1.0-2.6		500	250	100			500		
c. Maximum Net Loss Variation	dB	±4	±3	±2	±4	±2	±4	±4	
d. Maximum Change in Audio-frequency	Hz	±5	±5	±5	±5	±5	±5	±5	

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
e. Minimum Longitudinal Balance	dB	40	40	40	40	40	40	40	
f. Maximum Total Peak Telegraph Distortion	%								20
g. Maximum Mark or Space Bias Distortion	%								5
h. Maximum Allowable Channel Noise[2], [3], [4]	dBrnC0								
km / mi									
0-81 (0-50)		31	31	31	31	31	31	31	
82-161 (51-100)		34	34	34	34	34	34	34	
162-644 (101-400)		37	37	37	37	37	37	37	
645-1609 (401-1000)		41	41	41	41	41	41	41	
1610-2414 (1001-1500)		43	43	43	43	43	43	43	
2415-4024 (1501-2500)		45	45	45	45	45	45	45	
4025-6438 (2501-4000)		47	47	47	47	47	47	47	
6439-12874 (4001-8000)		50	50	50	50	50	50	50	
12875-25748 (8001-16000)		53	53	53	53	53	53	53	
i. Maximum Single Tone Interference Below Circuit Noise in Each Mileage Category[4]	dB	3	3	3	3	3	3	3	

[2]D1 and D2 allowable channel noise for Government-owned circuits 47 dBrnC0 for all distances shown above.

[3]Consider a satellite channel as equivalent to a 3219 kilometer (2000-mile) landline channel in determining circuit length.

[4]For circuits operating at 7200/9600 b/s, characteristic r replaces characteristic n. For circuits equipped with PCM terminals, C-Notched Noise should not exceed 47 dbrnC0 for all distances, and characteristic l does not apply.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
j. Impulse Noise Ref Level 71 dBrnC0 72 dBrn0 voice band wtg	Max Count in 15 min above ref level	15	15	15			15	15	
k. Terminal Impedance 600 ohm[5]	% tolerance	±10	±10	±10	±10	±10	±10	±10	
l. Composite Data Transmission Level	dBm0	-13	-13	-13	-13	-13	-13	-13	
m. Phase Jitter (peak-to-peak)	Degree	15	15	15			15	15	
n. Harmonic Distortion [6]	dBm0	-40	-40	-40	-40	-40	-40	-40	

[5]For Government-owned circuits measured across the frequency band of interest. This impedance is essentially resistive.

[6]Applies to the measurement of any of the harmonics of a test frequency of 704 Hz introduced at a level of -10 dBm0. This value equates to any harmonic 30 dB below the fundamental. For circuits operating at 7200/9600 b/s, Nonlinear Distortion (characteristic s) should be substituted for this parameter.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
o. Gain Hit[7,10] greater than 4 milliseconds duration	Max Count in 15 min								
Gain Change 3 dB or		8	8	8			8	8	
4 dB		6	6	6			6	6	
p. Phase Hit[8,10] exceeding 20 degrees and lasting longer than 4 milliseconds	Max Count in 15 min exceeding threshold	8	8	8			8	8	
q. Dropout[9,10] equal to or greater than 12 dB and exceeding a period of 10 milliseconds	Max Dropout in 15 min	2	2	2			2	2	

[7]Gain hits are sudden uncontrolled changes in the gain or loss of a channel. Changes lasting less than 4 milliseconds are classed as impulse noise.

[8]Phase hits are sudden uncontrolled changes in phase of the transmitted signal. Changes lasting less than 4 milliseconds are also classed as impulse noise.

[9]Dropouts are large reductions in channel gain.

[10]It is not intended that this parameter be measured routinely. Measurement will be made only at circuit activation and, if necessary, during unscheduled outages as a troubleshooting aid.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	S1	S2	S3	V1	V2	D1	D2	N (1-3)
r. Signal to C-Notched Noise Ratio[11,12]	dB	28		28					
s. Nonlinear Distortion[13] (1) Signal to second order distortion	dB	35		35					
(2) Signal to third order distortion		40		40					

[11]A frequency of 1004 Hz is introduced at -10 dBm0.

[12]This characteristic is applicable only to circuits operating at 7200 and 9600 bits/sec and replaces characteristic h for these circuits.

[13]This characteristic is applicable only to circuits operating at 7200 and 9600 bits/sec and replaces characteristic n for these circuits.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

(GROUP BANDWIDTH CHANNELS - FDM OR DATA DERIVED)

Characteristics	Unit of Meas	X1	X2
a. Frequency Response kHz loss with respect to 104.08 kHz	dB		
km / mi			
0-100 (0-62.5)		-1.3 to +1.8	-1.3 to +1.8
100-201 (62.5-125)		-2.0 to +2.9	-2.0 to +2.9
201-402 (125-250)		-2.5 to +4.0	-2.5 to +4.0
402-804 (250-500)		-2.9 to +4.0	-2.9 to +4.0
804-1609 (500-1000)		-3.3 to +4.9	-3.3 to +4.9
1609-3218 (1000-2000)		-4.4 to +4.9	-4.4 to +5.9
3218-6436 (2000-4000)		-4.4 to +6.7	-4.4 to +6.7
b. Envelope Delay (ref. 84 kHz)			
(1) Equalized parabolic curve 64-104 kHz	micro-sec		
km / mi			
0-100 (0-62.5)			-9.0 to +3.2[14]
100-201 (62.5-125)			-9.4 to +5.8
201-402 (125-250)			-9.7 to +8.0
402-804 (250-500)			-9.9 to +8.5
804-1609 (500-1000)			-10.1 to +10.5
1609-3218 (1000-2000)			-10.7 to +13.6
3218-6436 (2000-4000)			-10.9 to +14.9
(2) Unequalized, typical points on curve.			
Measured at 60 kHz		3000	
Measured at 64 kHz		300	
Measured at 108 kHz		2800	

[14]For AN/USC-26, refer to figure 1.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	X1	X2
c. Amplitude Stability	dB		
Short Term (< 30 sec)		±.5	±.5
Long Term (> 30 sec)		±1.0	±1.0
d. Maximum Frequency Offset	Hz	±2	±2
e. Impedance	ohm		
(1) Balanced (preferred)		135	135
(2) Unbalanced		75	75
f. Return Loss, minimum over frequency range 60-108 kHz	dB	25	25
g. Interface Transmission Level Point (assuming Government-furnished interconnect filters)	dBm		
Group Channel Input Level		-34.5	-5 to -42
Group Channel Output Level		-12.0	-5 to -42
h. Phase Jitter, Peak to Peak	degree	15	15

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS (CON.)

Characteristics	Unit of Meas	X1	X2
i. Random Noise Unweighted	dBm0		
km / mi			
0-804 (0-500)		-38	-38
804-1609 (500-1000)		-35	-35
1609-3218 (1000-2000)		-32	-32
3218-6436 (2000-4000)		-29	-29
j. Impulse Noise, Flat Weighting 15-Minute Measurement at -10 dBm0	Maximum Count	175	175
k. Average (30-second) Long-Term Power in 60-108 kHz band, maximum permissible	dBm0	-5	-5
l. Maximum Operating Signal Power permitted in any 4-kHz subchannel. Total number of active channels must be such that characteristic k is not violated.	dBm0	-13	-13
m. Maximum Test Tone Power Level in any 4-kHz subchannel	dBm0		
Test duration less than 5 minutes		-13	-13
Test duration more than 5 minutes		-16	-16

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS Y1[15]

Characteristic	Unit of Measure	Circuit Parameter Y1
Data Rate	megabits per second	1.544 +150 b/s -300 b/s
Data Signal Level Normal Modulation Scheme - Bipolar RZ, AMI[16] logic one logic zero Optional Modulation Scheme - NRZ[17] logic one logic zero	d.c. volt	 $\pm 3 \pm .5$ $0 \pm .005$ $+3 \pm .5$ $-3 \pm .5$
Impedance Normal Bipolar - Balanced Optional NRZ - Unbalanced	ohm	 100 75
Average Bit Error[18] Rate (BER) over worst 30-minute interval - maximum allowable	ratio of errored bits to total transmitted bits	$.90 \times 10^{-10} XL_1$* $1.45 \times 10^{-10} XL_2$**

[15]See footnote 23 in enclosure 2, table 1, page 13.
[16]Return to zero, alternate mark inversion (RZ, AMI).
[17]Nonreturn to zero (NRZ).
[18]For circuits that are not to be extended (i.e., direct user-to-user 1.544 Mb/s circuits), the BER requirement is 1×10^{-7} and the availability is 99 percent.
*L_1 = length in km.
**L_2 = length in statute miles.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

CIRCUIT PARAMETERS Y1

Characteristic	Unit of Measure	Circuit Parameter Y1
Circuit Availability Requirement	Percentage of time circuit was in and met BER	$1-(4.5 \times 10^{-7} \times L_1)$* $1-(7.24 \times 10^{-7} \times L_2)$**

*See footnote *, page 18.

**See footnote **, page 18.

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

Z1, Z2, Z3 TECHNICAL SCHEDULES

(Z1 through Z3 technical schedules establish the parameters for full-duplex 50 kb/s transmission media within the bandwidth of 0.1 to 50 kHz terminated in a nominal 135 ohms. The Z Schedules apply only to terminals operating in the baseband mode.

Z1 Parameters are for a local circuit used to interconnect two KY-3 terminals over physical metallic nonloaded cable pairs. The lineup loss must portray a curve with a smooth rolloff.

Z2 Parameters are for a local circuit used to interconnect a KY-3 to a switchboard over metallic facilities as in Z1. However, since the switchboard provides no equalization, all equalization on the cable pair transmitting toward the switchboard must be "equipped by the line." Note the different requirements in each direction.

Z3 Parameters are for a trunk circuit used between two switchboards where no equalization capability exists at either end. It applies also to any wireline segment of a wideband long haul trunk.)

Characteristic	Unit of Measure	Z1 Both Directions	Z2 Sub to Switch	Z2 Switch to Sub	Z3 Both Directions
1. Low-Frequency Noise[19,20]	dBm	<-36	<-36	<-36	<-36
2. S+N/N	dB	> 20	> 24	> 24	> 24
3. Impulse Noise[21] a. Wideband	1 count per second with threshold set at stated level (dB) below the received signal level	12	12	12	12
b. AN/FTC-31 low frequency receive	1 count per second with threshold set at stated level (dB) below 2600 Hz SF level		6		6

See page 22 for footnotes.

Enclosure 1

TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

Z1, Z2, Z3 TECHNICAL SCHEDULES

Characteristic	Unit of Measure	Z1 Both Directions	Z2 Sub to Switch	Z2 Switch to Sub	Z3 Both Directions
4. Net Loss Variation[20,22]	dB	±2	±2	±2	±2
5. Lineup Loss (kHz)	dB loss of OdBm		(23)		
a. 0.1	transmitted	+13	< 4	+10	
1.0	tone	+12	< 4	+ 9	
3.0		+14	< 4	+10	
5.5		+17	< 4	+12	
10.0		+20	< 4	+14	
18.0		+23	< 4	+17	
25.0		+25	≤ 4	+19	
32.0		+27		+21	
50.0		+30	6	+24	
			(23&24)	(25)	
b. .1 to 50.0			-2, +2	-2, +2	-2, +2
1.0 to 40.0			-1, +1	-1, +1	-1, +1
6. Envelope Delay	Microsec ref @ 6 kHz	See figure 2	See figure 2	See figure 2	See figure 2
7. Nominal Data Input Signal Level	volts peak to peak	1	1	1	1

See page 22 for footnotes.

NOTES. 19. In no case should absolute power level exceed -36 dBm in the VF bandwidth.

20. Reference frequency is 1 kHz at 0 dBm0.

21. The impulse noise (IPN) meter is normally configured for dBrn. After measuring the received digitized voice signal with a dB meter, use the following equation for the dBrn setting:

dBrn = 90 + signal level (measured reading) - 12 dB

Example: If the signal level is measured to be -2 dBm, then dBrn = 90 - 2 - 12 = 76 dBrn. Set reference level dBrn dials as follows:

10 dB step dial at 60.
High-level dial at 16. (60 + 16 = 76 dBrn)
Mid-level dial at 10. (60 + 10 = 70 dBrn)
Low-level dial at 4. (60 + 4 = 64 dBrn)
Use 10.2 to 51 kHz (or external wideband) filter.

22. At the time of the alignment of the wideband repeaters in the subscriber to switch direction, adjust the receive level of the 1 kHz reference frequency to 0 dBm with the entire frequency response within the stated specifications (-1 to +1 dB between 1 and 40 kHz and -2 to +2 dB between .1 to 50 kHz). In a later check, the reference 1 kHz receive level may vary (net loss variation) up to -2 or +2 dB from the 0 dB alignment level. The entire frequency curve should be equally displaced. For example, if the 1 kHz tone is 1 dB cold (or reading -1 dB on the meter indicating a +1 dB loss), then the entire frequency response curve must now be referred to the +1 dB loss level. The frequency response curve must fall within the shifted limits of 0 to +2 dB between 1 and 40 kHz and -1 to +3 dB between .1 to 50 kHz. If the 1 kHz tone is 2 dB hot, then the frequency response curve must fall within the limits of -3 and -1 dB between 1 and 40 kHz and -4 to 0 dB between .1 and 50 kHz.

23. A 4 dB loss at 25 kHz is maximum allowable loss. Loss from 0.1 to 18.0 kHz should be less than 4 dB. If the 25 kHz loss exceeds 4 dB, then the lineup loss will be as listed in 5b and will require a WB repeater.

24. For those switches which have WECO 824/303 units on the wideband interswitch trunks or on long-distance wideband subscriber lines, all other subscribers on that switch must meet the lineup loss as listed in 5b to provide sufficient input level to the WECO units.

25. If the loss limits listed in item 5a cannot be met, wideband repeater(s) will be required and the lineup loss will be as listed in item 5b.

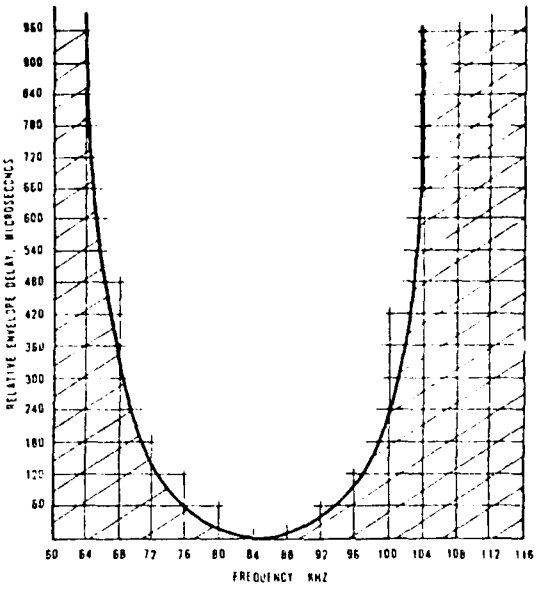
TABLE 2. DCS TECHNICAL SCHEDULES FOR GOVERNMENT-OWNED CIRCUITS (CON.)

Z4 TECHNICAL SCHEDULE

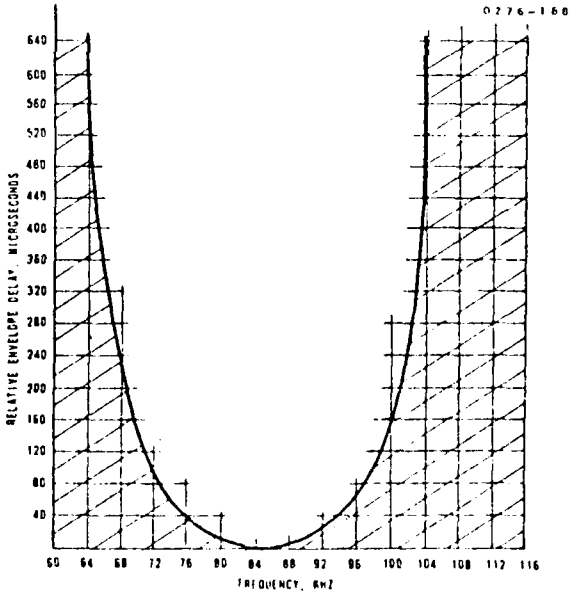
(Z4 Parameter is for 50 kb/s long-distance circuits used between two switchboards over FDM or TDM radio carrier facilities. Special converters (842 data auxiliary set or CV 3034) are used to facilitate analog signaling over the channel. The nominal analog channel impedance is 135 ohms, balanced. Wirelines used to extend either or both ends of Z4 circuits will be designated as Z3 circuits and included in the Z4 testing.)

Characteristic	Unit of Measurement	Z4 Value
1. Error Rate Objective	error rate/time	(26)
2. Jitter from Terminal Equipment (Maximum)	% isochronous distortion, P-P Jitter	20
	microseconds	4
3. Jitter to Terminal Equipment (Maximum)	% isochronous distortion P-P jitter, assumes 0-20% jitter from terminal equipment	33
	microseconds	6.7
4. Nominal Input and Output Data Signal Level	dBm0	0 ± 2 dB

[26]The Block Error Rate (BKER) shall not exceed 15 blocks (50,000 bits to one block) in error during a 15-minute measuring period. An errored block is counted when nine or more bits are in error. The average Bit Error Rate (BER) shall not exceed 1×10^{-5} for any 15-minute interval.



Relative Envelope Delay for Simulated Circuit Tests, Rates Below 115.2 kb/s[1]

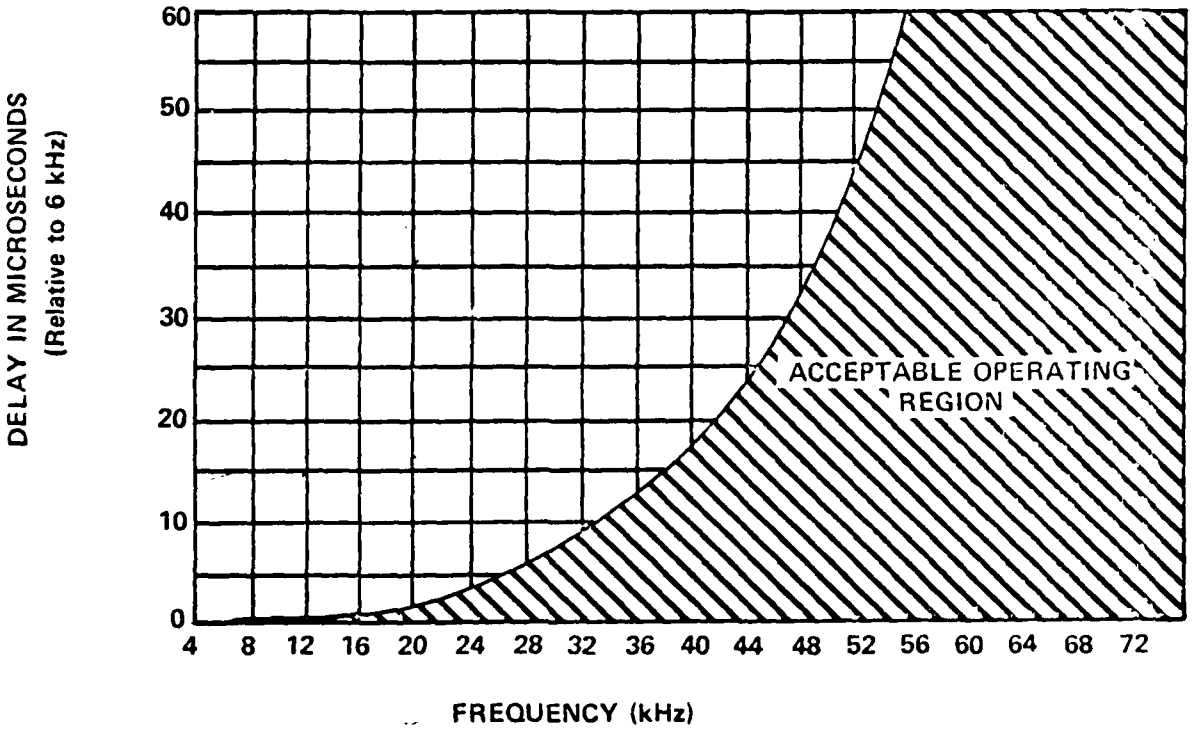


Relative Envelope Delay for Simulated Circuit Tests at 115.2 and 153.6 kb/s[1]

FIGURE 1. RELATIVE ENVELOPE DELAY FOR AN/USC-26

[1]Envelope delay curves are design test specifications extracted from T.O.31W2-2USC26-2/TM11-5805-692-14/NAVELEX 0967-LP-548-7010, 1 Oct 76.

Enclosure 1



NOTES.

1. Above curve represents envelope delay requirements. Limits are not specified below 6 kHz.
2. If the entire circuit consists of equalized twisted pair cable from which all loading coils and bridge taps have been removed, no delay equalization should be required. Given the correct frequency response over the range of .1 to 50 kHz (no discontinuities or sharp rolloffs), envelope delay will not normally be an item for concern on cable pairs.
3. Should the circuit contain carrier facilities, delay equalization must be employed so that the delay-versus-frequency response of the circuit is a smoothly and continuously increasing function of frequency, which falls within the shaded area of this figure.

FIGURE 2. RELATIVE ENVELOPE DELAY VS. FREQUENCY

DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED IN CONUS[1]

1. Contents. The contents of this enclosure are described in paragraph 7c of the Circular. Table 1 applies to circuits leased from AT&T and concurring carriers. Tables 2 and 3 contain technical parameters for basic (2001, 3001, and 3002) channels and C1 through C5 conditioning. Tables 4, 5, and 6 contain technical parameters for wideband secure voice circuit conditioning (G-1, G-2, and G-3). Table 7 applies to circuits leased from Western Union. The Western Union tariff no longer refers to the 1000, 2000, or 3000 type channels. However, for convenience, these designations have been used in the enclosure. The new Western Union designations for channels are:

a. LSCS - Low-Speed Channel Service (up through 300 baud)

b. SSDCS - Specific Speed Data Channel Service (600-2400 baud)

c. VGCS - Voice Grade Channel Service (over 2400 through 9600 baud, Voice and Alternate Voice/Data)

2. Procedures for Obtaining Reference Documents. The tables in this enclosure refer to various Bell System Technical References (BSTR's) and Bell System Practices (BSP's). Activities desiring to obtain copies of BSTR's and BSP's should address their requests as follows:

Army activities	Commander USACEEIA ATTN: CCC-DRM-T Fort Huachuca, AZ 85613
Navy activities	Western Electric ATTN: Government and Commercial Sales P.O. Box 20046 Greensboro, NC 27420
Air Force activities	NCA - EIEXR Griffiss AFB, NY 13441
Defense agencies and other activities	DCEC/R110 1860 Wiehle Avenue Reston, VA 22090

[1] This enclosure indicates various tariffed service offerings currently available from and recommended by U.S. common carriers to meet Government requirements for the listed telecommunications services. The information contained herein provides a reference for use in leasing commercial communications services and a yardstick for evaluating leased circuits in use in the DCS today. Inclusion of this information in this Circular does not constitute Department of Defense endorsement of the suitability of such commercial services for use in the DCS nor of the adequacy of specified parameters to meet Government service needs.

3. Information Pertaining to AT&T Channel Types. Technical information for the following AT&T channel types will be added as it becomes available: 1002, 1005, 1006, 2007, 2008, 2009, 2010, 5701, and 5706. As an interim measure, the following information pertaining to these channel types has been extracted directly from Tariff FCC 260.

a. Type 1002. Transmission up to 55 bauds for teletypewriter, teletypesetter, data or remote metering, supervisory control and miscellaneous signaling purposes, or transmission up to 45 bauds for morse.

b. Type 1005. Transmission up to 75 bauds for teletypewriter, teletypesetter, data or remote metering, supervisory control, and miscellaneous signaling purposes.

c. Type 1006. Transmission up to 150 bauds for teletypewriter, data or remote metering, supervisory control and miscellaneous signaling purposes.

d. Type 2007.

(1) These channels are furnished wholly within the Washington metropolitan area, to a Department or Agency of the U.S. Government. Approximate bandwidth of 10-50,000 Hertz. Furnished for two-point secure communication on 2-or 4-wire metallic facilities between customer stations and/or switches (T-3 conditioning). Voice frequency signaling or supervisory tones can be transmitted.

(2) Channels are conditioned so that the absolute loss (referenced to 1 milliwatt) with respect to frequency shall not exceed:

(a) 15 dB at 10 Hz

(b) 13 dB at 100 Hz

(c) 12 dB at 1,000 Hz

(d) 20 dB at 10,000 Hz

(e) 30 dB at 50,000 Hz

(3) Additional conditioning (available in one or two directions on 4-wire facilities only) to provide the following characteristics:

(a) The absolute loss (referenced to one milliwatt) with respect to frequency shall not exceed:

(1) 0 dB at 1,000 Hz

(2) $\pm$ 1 dB between 1,000 Hz and 40,000 Hz

(3) $\pm$ 2 dB between 10 Hz and 50,000 Hz (+ means more loss)

(b) The net loss of the conditioned channel (with or without additional conditioning) shall not vary by more than 4 dB at 1,000 Hz from the levels specified above.

e. Type 2008.

(1) These channels are furnished wholly within the Washington metropolitan area to a Department or Agency of the U.S. Government. Approximate bandwidth 10-50,000 cycles per second. Furnished on 4-wire metallic facilities for duplex operation for two-point secure communication between customer stations (G-1 conditioning). Voice frequency signaling or supervisory tones can be transmitted.

(2) Channels are conditioned so that the absolute loss with respect to frequency and the net loss variation shall be the same as Type 2007 channels without additional conditioning.

f. Type 2009.

(1) These channels are furnished wholly within the Washington metropolitan area to a Department or Agency of the U.S. Government. Approximate bandwidth 10-50,000 cycles per second. Furnished on 4-wire metallic facilities for duplex operation for two-point secure communication between a customer station and a switching point (G-2 conditioning). Additional conditioning is required at one terminal. Voice frequency signaling or supervisory tones can be transmitted.

(2) Channels are conditioned so that the absolute loss with respect to frequency and net loss variation from the switch to the customer station shall be the same as Type 2007 channels without additional conditioning and from the customer station to the switch shall be the same as Type 2007 channels with additional conditioning.

g. Type 2010.

(1) These channels are furnished wholly within the Washington metropolitan area to a Department or Agency of the U.S. Government. Approximate bandwidth 10-50,000 cycles per second. Furnished on 4-wire metallic facilities for duplex operation for two-point secure communication between two switching points (G-3 conditioning). Additional conditioning is required at each terminal. Voice frequency signaling or supervisory tones can be transmitted.

(2) Channels are conditioned so that the absolute loss with respect to frequency and the net loss variation shall be the same in both directions of transmission as Type 2007 channels with additional conditioning.

h. Type 5701. Service terminals. The channel or channels developed by each service terminal require the interchange channel capacity equivalent to twelve voice channels. These service terminals are used as follows:

(1) To terminate a channel having a frequency bandwidth of approximately 10 to 20,000 cycles per second with only minor deviation to gain and delay characteristics within this frequency range.

(2) To accommodate the transmission of data signals at a rate of 40,800 bits per second in sequence. One voice channel termination is included for coordination purposes.

(3) To accommodate the transmission of two-level sequential nonsynchronous facsimile signals with a minimum signal element width of 20 microseconds or sequential synchronous signals at a rate of 50,000 bits per second or two-level isochronous data signals at a rate of 43,000 bits per second (plus or minus 430 bits per second) where the customer is a Department or Agency of the U.S. Government and provides the necessary equipment for scrambling the data bit stream. Arrangements for terminating a voice channel for coordination purposes are also included. At the customer's option a supplementary control arrangement will be provided suitable for simultaneously conditioning three signals, one from each of two groups of five possible signals and one from a group of four possible signals, at rates up to 20 such combinations per second for transmission in lieu of, or alternate to, voice use of the coordination channels.

(4) To accommodate the transmission of sequential isochronous signals at a rate of 48,000 bits per second. Arrangements for terminating a voice channel for coordination purposes are also included. An incremental arrangement is required for transmission of data at 48,000 bits per second. This incremental arrangement is limited for use by a Department or Agency of the United States Government.

i. Type 5706. Service terminals furnished to a Department or Agency of the United States Government. They are arranged to accommodate binary digital baseband signals in a random polar format at the rate of 50,000 bits per second from customer-owned equipment for the transmission of secure communications. Arrangements are also included to accommodate the nonsimultaneous transmission of signal and supervisory tones between the frequencies of 300 and 3000 cycles per second. The channels developed by each service terminal require interexchange channel capacity equivalent to 12 voice channels.

4. High-Performance Data Conditioning (Bell D1)[2]

a. Certain data transmission characteristics necessary for high-performance data transmission cannot be assured on all facilities generally available for data transmission. However, Type 3002, Type 5032, Type 5302, and Type 8302 voice grade two-point and three-point channels may be specifically arranged at the request of the customer to provide for the following technical parameters:

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[2] Information from Tariff FCC 260, 10th Revised Page 143.3, effective July 9, 1979.

(1) Signal to C-Notched Noise Ratio 28 dB

(2) Nonlinear distortion:

(a) Signal to second order distortion 35 dB

(b) Signal to third order distortion 40 dB

b. High-performance data conditioning for Type 3002, Type 5302, and Type 8302 Channels is furnished as follows:

(1) Type D1. For a two-point channel not arranged for switching where there is not more than one station per service point.

(2) Type D2. For a two-point or three-point channel where there is not more than three stations per channel. Type D2 conditioning includes a Telephone Company provided switching arrangement which permits the transmission of data between a control station designated by the customer and either of two outlying stations, one station at a time. Only one such switching arrangement may be provided on any given service. Any service so arranged may not be switched to any other service. When the key control for the switching arrangement is located in a different exchange than the switching arrangement, rates for a Type 1001 channel apply for the remote control channel between exchanges.

(3) Type D3. For Switched Circuit Automatic Network access lines.

c. When the channel equipped with these types of conditioning is utilized for voice communications, the Telephone Company does not undertake to represent that the channel will be suitable for such voice transmission.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	Technical Schedules pertinent to services not mentioned herein will be developed on a case-by-case basis as requests for these services are received by the responsible DCA Circuit Allocation and Engineering Organization. When warranted by tne degree of usage, an appropriate Technical Schedule for the particular service will be published by DCA.			
	CATEGORY 1: USER-TO-USER CIRCUITS VOICE			
1A	Nonsecure voice circuit.	V1	2001	Basic
1B	Secure voice, operating at 2400 baud.	S1	2001	C-2(1)
1C	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to transmission over metallic facilities without regenerators.	Z1	2008	G-1(2)
1D	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to long-distance transmission over radio systems.	Z4	5706	(3)
1E	Alternate voice/record, including secure voice or data, operating at rates from 2400 b/s up to 9600 b/s. Circuit parameter code S3 is not available for user-to-user service but was developed to permit interconnection of up to five tandem S3 links and still obtain S1 circuit performance on an end-to-end basis.	S1	2001	(1) (4)

[1]Bell System Technical Reference PUB 41004.
[2]Special conditioning is in accordance with BSP 880-500-110.
[3]Special conditioning is in accordance with BSP 880-510-100.
[4]For 2400 b/s Basic Channel equipped with 201C Data Set, 4800 b/s Basic Channel equipped with 208A Data Set, or 9600 b/s D-1 Conditioning equipped with 209A Data Set.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	CATEGORY 1: USER-TO-USER CIRCUITS (CON.)			
	FACSIMILE			
1F	Facsimile transmission which can be accommodated over a voice grade channel with no special conditioning. If the required facsimile (including telephoto) service involves special conditioning of the channel, specific circuit parameters will be based on transmission means, circuit length, and characteristics of the equipment used to terminate the circuits.	V1	3002	Basic
	TELEGRAPH AND DATA			
1G	Less than 46 baud. *Includes 60 wpm* teletypewriter and other d.c. keying service.	N1	1002	-
1H	46 through 75 baud. Includes 75 wpm and 100 wpm teletypewriter and other d.c. keying service.	N2	1005	-
1J	76 through 150 baud. Includes 110 baud teletypewriter and other d.c. keying service.	N3	1006	-
1K	Less than 46 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1L	46 through 75 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1M	76 through 150 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1N	066-068 IBM transceivers (10 to 40 cpm).	V1	3002	Basic

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	TELEGRAPH AND DATA (CON.)			
1P	300 through 600 baud. Includes data card or other service.	D2	3002	Basic
1Q	1200 baud. Includes data card or other service.	D2	3002	Basic
1R	2400 b/s; alternate voice/record service.	S1	3002	C-2(6)(7)
1S	4800 b/s; alternate voice/record service.	S1	3002	(6)(7)
1T	9600 and 7200 b/s; alternate voice record service.	S1	3002	D-1(8)
	CATEGORY 2: VOICE FREQUENCY CARRIER TELEGRAPH (VFCT) SYSTEMS			
2A	VFCT, type 1. Up to 16 telegraph channels.	D2	3002	Basic
2B	VFCT, type 2. Up to 26 telegraph channels provided over a voice frequency channel between carrier terminals.	S1(5)	3002	C-4(6)

[5]See footnote 1, enclosure 1, table 1, page 3.
[6]See footnote 1, page 6.
[7]For 2400 b/s C-2 Conditioning equipped with 207 Data Set or Basic Channel equipped with 201C Data Set.
[8]Special conditioning in accordance with BSP 314-410-105 when 209 Data Set is specified.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	CATEGORY 3: AUTOVON ACCESS LINES			
3A	Voice grade.	V2	2001	Basic
3B	Special grade, alternate voice/record access from AUTODIN switch, and 2400 through 9600 b/s secure voice access from secure voice terminals, cordboard (SECORD), SEVAC, and other secure four-wire switchboards.	S3	2001	(9)(10)
3C	Special grade, alternate voice/record.	S3	2001	C-3(9)
	CATEGORY 4: AUTOVON TRUNKS			
4A	Interswitch voice grade.	V2	2001	ACG(11)
4B	Interswitch special grade, not trans-oceanic (no regenerators at either end).	S3	2001	ACG(11)
4C	Interswitch special grade, not trans-oceanic (regenerators at both ends).	S1	2001	ACG(11)
4D	Interswitch special grade, not trans-oceanic (regenerators at one end).	S2	2001	ACG(11)
4E	Interswitch special grade, alternate voice/record.	S3	2001	ACG(11)
4F	Loop-around, regenerative, Option 1. Regenerators located physically at the AUTOVON Switching Center.	S3	2001	C-3(9)
4G	Loop-around, regenerative, Option 2. Regenerators located physically at a remote site on Government property.	S3	2001	C-3(9)

[9]See footnote 1, page 6.
[10]For 2400 b/s Basic channel equipped with 201C Data Set;
for 4800 b/s Basic channel equipped with 208A Data Set;
for 9600 b/s D3 Conditioning equipped with 209A Data Set.
[11]ACG AUTOVON Common Grade in accordance with BSP 851-101-100.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	CATEGORY 5: AUTODIN ACCESS LINES			
5A	75 baud; d.c. keying.	N2	1005	-
5B	150 baud; d.c. keying.	N3	1006	-
5C	75 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5D	150 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5E	300 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5F	600 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5G	1200 baud; limited to data service only.	D2	3002	Basic
5H	1200 b/s multiplexed; from a user or transmission nodal point where a VF channel is multiplexed or bridged with any compatible combination of 75-, 150-, 300-, or 600-baud modems not to exceed 1200 b/s total. VF bridging is used at transmission nodal points to serve noncollocated users.	D2	3002	Basic
5I	Not used.			
5J	2400 b/s; alternate voice record.	S1	3002	C-2[12]
5K	Not used.			
5L	Not used.			

[12]See footnote 1, page 6.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	CATEGORY 5: AUTODIN ACCESS LINES (CON.)			
5M	4800 b/s; alternate voice/record service.	S1	3002	Basic
5N	Not used.			
5O	Not used.			
5P	Not used.			
5Q	9600 and 7200 b/s; alternate voice record data service.	S1	3002	D-1(13)
	CATEGORY 6: AUTODIN INTERSWITCH TRUNKS			
6A	2400 b/s through 4800 b/s; dedicated circuit from one AUTODIN switch to another.	S1	3001	(14)(15)
6B	Not used.			
6C	9600 and 7200 b/s; alternate voice/ record service.	S1	3001	D-1(13)
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES			
7A	Not used.			
7B	Secure voice terminal, 2400 b/s, to four-wire JOSS or AUTOVON switch.	S3	2001	C-5(14)
7C	Secure voice terminal, 50 kb/s baseband, to SECORD to AUTOSEVOCOM switching facility without regenerators over metallic facilities.	Z2	2009	G-2(16)

[13]See footnote 8, page 8.
[14]See footnote 1, page 6.
[15]For 2400 b/s, C-2 Conditioning and for 4800 b/s Basic Conditioning.
[16]Special conditioning in accordance with BSP 880-500-111.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260	
			CHAN. TYPE	COND.
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES (CON.)			
7D	Secure voice terminal, 50 kb/s baseband, to special 758 switch or cordboard (SECORD) or AN/FTC-31 over long-distance carrier facilities.	Z4	5706	-
7E	Secure voice terminal, 50 kb/s baseband, to AN/FTC-31, over metallic facilities.	Z1	2008	G-1(17)
7F	Secure voice terminal, operating at 9600 b/s to JOSS or AUTOVON switch.	S3	2001	D-3
	CATEGORY 8: AUTOSEVOCOM TRUNKS			
8A	50 kb/s baseband, over metallic facilities without regenerators.	Z3	2010	G-3(18)
8B	50 kb/s baseband, over long-distance carrier facilities.	Z4	5706	-
8C	Not used.			
8D	2400 b/s (JOSS to either a JOSS or a cordboard (SECORD)).	S3	2001	C-5(19)
8E	2400 b/s (SEVAC to JOSS or 5-D switchboard).	S3	2001	C-5(19)
8F	Interswitch trunk operating at 9600 b/s providing secure voice service. (This service is derived from the AUTOVON.)	S1	2001	ACG(20)

[17]See footnote 2, page 6.
[18]Special conditioning in accordance with BSP 880-500-112.
[19]See footnote 1, page 6.
[20]See footnote 11, page 9.

TABLE 1. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM AT&T AND CONCURRING CARRIERS (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	AT&T TARIFF FCC 260 CHAN. TYPE	AT&T TARIFF FCC 260 COND.
	CATEGORY 9: 60-108 kHz BASIC GROUPS			
9A	Frequency Division Multiplexing (FDM) Use. This item should be specified whenever a DCS 60-108 kHz channel is equipped with GFE FDM equipment at DCS station locations.	X1	(21)	
9B	Derivation of 50 kb/s Data Service. This item should be specified whenever a 60-108 kHz channel is required to interconnect 50 kb/s points in the DCS by use of a special GFE modem and GFE auxiliary set (such as WECO type 303 data modem and WECO type 842 data auxiliary set which provides interconnection of subscribers on a 4-kHz basis whenever the 50 kb/s signal is removed from the user's 4-wire line.) The derived service is similar to item 7D. The AN/USC-26 group data modem may also be used in deriving this service, but in the half group mode of operation the data signal level (Circuit Parameter Code X2, item k, table 2) should be reduced to -8 dBm0.	X2	5701	-
	CATEGORY 10: 1.544 Mb/s BASIC DIGROUPS			
10A	Time Division Multiplexing (TDM) Use. This should be specified whenever a 1.544 Mb/s circuit is equipped with PCM equipment at DCS station locations. Generally used to derive 24 voice channels, but data channels may also be derived.	Y1	AT&T Tariff FCC 267(22,23)	

[21]Not offered by AT&T.

[22]If provided via communications satellite system, this service is covered in Tariff 258.

[23]Refer to Technical Reference 41451. The rates and service quality standards (e.g., conditioning) for AT&T Tariff FCC Nos. 258 and 267 provided 1.544 Mb/s service are currently at issue in FCC Docket No. 20690. Reference to AT&T Tariff FCC Nos. 258 and 267 does not constitute endorsement or acceptance of the service quality standards contained therein as adequate to meet Government service requirements. The DCS Circuit Parameter Code Y1 is also repromulgated only on an interim basis until the final resolution of the matters at issue in FCC Docket No. 20690. At that time Code Y1 will be adjusted as necessary for both Government-owned and commercially leased circuits.

TABLE 2. **BANDWIDTH PARAMETER LIMITS # ≠**

Channel Conditioning	Attenuation Distortion (Frequency Response) Relative to 1004 Hz: Frequency Range (Hz)	Variation (dB) **	Envelope Delay Distortion: Frequency Range (Hz)	Variation (microseconds)
Basic	500-2500	−2 to +8	800-2600	1750
	300-3000	−3 to +12		
C1	*1000-2400	−1 to +3	*1000-2400	1000
	* 300-2700	−2 to +6	800-2600	1750
	300-3000	−3 to +12		
C2	* 500-2800	−1 to +3	*1000 2600	500
	* 300-3000	−2 to +6	* 600-2600	1500
			* 500-2800	3000
C3 (access line)	* 500-2800	−0.5 to +1.5	*1000-2600	110
	* 300-3000	−0.8 to +3	* 600 2600	300
			* 500 2800	650
C3 (trunk)	* 500-2800	−0.5 to +1	*1000-2600	80
	* 300-3000	−0.8 to +2	* 600 2600	260
			* 500 2800	500
C4	* 500-3000	−2 to +3	*1000 2600	300
	* 300-3200	−2 to +6	* 800 2800	500
			* 600-3000	1500
			* 500 3000	3000
C5	* 500-2800	−0.5 to +1.5	*1000 2600	100
	* 300-3000	−1 to +3	* 600 2600	300
			* 500-2800	600

C-conditioning applies only to the attenuation and envelope delay characteristics.

≠ Measurement frequencies will be 4 Hz above those shown. For example, the basic channel will have 2 to +8 dB loss, with respect to the 1004 Hz loss, between 504 and 2504 Hz

*These specifications are tariffed items

**(+) means loss with respect to 1004 Hz
(−) means gain with respect to 1004 Hz

Enclosure 2

TABLE 3. SPECIFICATIONS COMMON TO STANDARD DESIGN VOICEBAND DATA CHANNELS

APPLICATION

1. Alternate voice/data or data only
2. Two-point or multipoint layout (Note 1)
3. Two-wire or four-wire termination.
4. One-way, two-way simultaneous, or two-way nonsimultaneous transmission.

INTERFACE PARAMETERS FOR TERMINAL EQUIPMENT

1.	Recommended impedance of terminal equipment	600 ohms ± 10% resistive over the voiceband and balanced (Note 2)
2.	Recommended isolation to ground of terminal equipment	At least 20 megohms dc At least 50 kilohms ac (300-3000 Hz) At least 1500 volts rms breakdown voltage at 60 Hz
3.	Data signal power (above 300 Hz): Maximum transmitted:	0 dBm (3 second average) + 13 dBm (instantaneous) (Note 3)
	Received power of 1004 Hz test tone (at installation):	−16 dBm ± 1 dB (Note 4)
4.	Maximum test signal power:	same as data signal power (Note 4)
5.	In band transmitted signal power:	signal power in 2450 to 2750 Hz band should not exceed signal power in 800 to 2450 Hz band if Bell System SF signaling is used, or if the signal can have access to the Switched Telecommunications Network
6.	Out of band transmitted signal power	

Above the Voiceband

(a) Power in band from 3995 to 4005 Hz at least 18 dB below maximum allowed in band signal power

(b) Power in band from 4 to 10 kHz less than −16 dBm

(c) Power in band from 10 to 25 kHz less than −24 dBm

(d) Power in band from 25 to 40 kHz less than −36 dBm

(e) Power in band above 40 kHz less than −50 dBm

Below the Voiceband:

Where signal components below 300 Hz, excluding ringing, are applied, the rms currents and voltages (including harmonics and spurious signals) at the interface shall not exceed the following.

(f) rms current per conductor as specified by the Telephone Company, but never to exceed 0.35 ampere

(g) Magnitude of peak conductor to ground voltage not to exceed 70 volts.

(h) Conductor to conductor voltage shall be such that conductor to ground voltage is not exceeded. For ungrounded signal source conductor to conductor limit is the same as conductor to ground limit.

(i) Total weighted rms voltage in band from 50 to 300 Hz not to exceed 100 volts. Weighting factors for each frequency component f are $f^2/10^4$ for f between 50 and 100 Hz, and $f^3 3/10^6 6$ for f between 100 and 300 Hz.

TRANSMISSION CHANNEL PARAMETER LIMITS COMMON TO ALL BASIC AND C-CONDITIONED STANDARD DESIGN CHANNELS

1. 1004 Hz loss variation: no more than ±4 dB long term (12 dB to 20dB) and no more than ±3 dB short term (Note 5).
2. C message noise: (Note 6)

Facility miles	Maximum noise at modem receiver (assumes standard design channel)
0-50	28 dBrnc
51-100	31
101-400	34
401-1000	38
1001-1500	40
1501-2500	42
2501-4000	44
4001-8000	47
8001-16000	50

3. C message notched noise: at least 24 dB below received 1004 Hz test tone power (Notes 4, 7)
4. Impulse noise:

Threshold with respect to received 1004 Hz test tone power	Maximum counts above threshold allowed in 15 minutes
−6 dB	15
−2 dB	9
+2 dB	5

5. Single frequency interference: at least 3 dB below C message noise limits
6. Frequency shift: no more than ±5 Hz
7. Phase intercept distortion: not controlled
8. Phase jitter: no more than 10° peak to peak
9. Nonlinear distortion (harmonic distortion):
   fundamental to second harmonic: 25 dB minimum
   fundamental to third harmonic: 30 dB minimum
10. Peak to Average Ratio (P/AR): not specified
11. Echo: first listener echo at least 12 dB below signal (Note 8)
12. Phase hits: not specified (Note 9)
13. Gain hits: not specified (Note 9)
14. Dropouts: not specified (Note 9)

TABLE 3. SPECIFICATIONS COMMON TO STANDARD DESIGN VOICEBAND DATA CHANNELS (CONT'D)

Note 1: C4 conditioning 2-, 3-, or 4-point only
C5 conditioning 2-point only
Duplex multipoint with 3002 channel only (not available with 2001 channel).

Note 2: Balanced operation is required (e.g., do not ground either side of the facility) but the degree of balance and method of measurement are not presently specified.

Note 3: Signals having instantaneous power more than 13 dB above the allowed 3-second average power may be distorted and may also interfere with services on other channels. The composite instantaneous signal power for signal components between 300 and 3995 Hz at a 0 dBm transmit point must not exceed + 13 dBm (3.46 volts peak) across a 600 ohm resistive load.

Note 4: The Bell System test signal at the input to a standard 16 dB loss channel is a 1004 Hz tone at 0 dBm.

Note 5: The short term variation specification will eventually be replaced by a gain hit specification. "Short term" refers to periods of several seconds, but not to hours or days. "Long term" refers to periods of days, weeks, or a few months.

Note 6: C-message noise limits apply at the modem receiver in the absence of a received signal. For voice operation with Bell System equipment in alternate voice/data operation, the C-message noise at the telephone receiver differs from the data limits given, and depends upon channel design. The limits are given in dBrnc. The "c" refers to C-message weighting. "dBrn" is dB above reference noise, where reference noise is -90 dBm. Note the mileage bands are facility miles, not airline miles.

Note 7: C-message notched noise provides an indication of the signal-to-noise ratio. This measurement simulates normal operation of compandors and other channel equipment.

Note 8: Although included under transmission parameters, echo is also affected by a terminal impedance other than 600 ohms resistive.

Note 9: Limits under consideration.

TABLE 4. G-1 Conditioning — Transmission Objectives

1. GENERAL	
Type of Service	2 point
Mode of Operation	4-wire, full duplex
Impedance-Source & Load	135 ohms, nominal midband, balanced
Maximum Signal Power Input/Output	0 dbm (rms power)
2. ATTENUATION	
Line-up 135 ohms Insertion Loss (Maximum)	10 c/s 15 db 100 c/s 13 db 1 kc/s 12 db 10 kc/s 20 db 50 kc/s 30 db
3. MAXIMUM LOSS VARIATION	±4 db referred to actual line-up loss. (See Par. 3.03.)[1]
4. SIGNAL-TO-NOISE RATIO	Equal to or better than 20 db. (See Par. 3.04.)[1]
5. IMPULSE NOISE	Not more than one (1) peak per second exceeding a level 12 db below peak signal level. (See Par. 3.05.)[1]
6. ENVELOPE DELAY	No specified requirement. (See Par. 3.06.)[1]

[1] Bell System Practices 880-500-110

TABLE 5. G-2 Conditioning — Transmission Objectives

1. GENERAL	
Type of Service	Multipoint-Switched
Mode of Operation	Full Duplex
Termination	4-wire
Impedance — Source and Load	135 ohms, nominal midband, balanced
Maximum Signal Power Input Output	0 dbm (rms power)
2. ATTENUATION CHARACTERISTICS	
Station to Switch	
Line-up 135-ohm insertion loss (maximum referred to 1 kc)	1.0 kc 0 db 1.0 kc to 10 kc +1 db 10 cps to 50 kc +2 db
Switch to Station	Requirements for G-1 conditioning apply.
3. MAXIMUM LOSS VARIATION	±4 db referred to actual line-up loss.
4. SIGNAL-TO-NOISE RATIO	Equal to or better than 20 db rms/rms.
5. IMPULSE NOISE	Not more than one (1) peak per second exceeding a level 12 db below peak signal level.
6. ENVELOPE DELAY	No specific requirements (See Section AB28.176.1 Par. 3.06)[1].

[1] Bell System Practices 880-500-110

TABLE 6. **G-3 Conditioning — Transmission Objectives**

1. GENERAL	
Type of Service	Point-to-Point or switched
Mode of Operation	Full Duplex
Termination	4-wire
Impedance — Source and Load	135 ohms, nominal midband, balanced
Maximum Signal Power Input/Output	0 dbm (rms power)
2. ATTENUATION CHARACTERISTICS	
Line-up Loss	1.0 kc 0 db 1.0 kc to 40 kc ±1 db 10 cps to 50 kc ±2 db
3. MAXIMUM LOSS VARIATION	±4 db referred to actual line-up loss.
4. SIGNAL-TO-NOISE RATIO	Equal to or better than 20 db rms/rms.
5. IMPULSE NOISE	Not more than one (1) peak per second exceeding a level 12 db below peak signal level.
6. ENVELOPE DELAY	No specific requirement (See Section AB28.176.1, Par. 3.06).[1]

[1] Bell System Practices 880-500-110

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254 CHAN. TYPE	WU TARIFF FCC 254 COND.
	Technical Schedules pertinent to services not mentioned herein will be developed on a case-by-case basis as requests for these services are received by the responsible DCA Circuit Allocation and Engineering Organization. When warranted by the degree of usage, an appropriate Technical Schedule for the particular service will be published by DCA. CATEGORY 1: USER-TO-USER CIRCUITS VOICE			
1A	Nonsecure voice circuit.	V1	2001	Basic
1B	Secure voice, operating at 2400 baud.	S1	3002	Basic
1C	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to transmission over metallic facilities without regenerators.	Z1	9000(1)	
1D	Secure voice, operating at 50,000 b/s. This is a special schedule pertaining to long-distance transmission over radio systems.	Z4	8803	
1E	Alternate voice/record, including secure voice or data, operating at rates from 2400 b/s up to 9600 b/s. Circuit parameter code S3 is not available for user-to-user service but was developed to permit interconnection of up to five tandem S3 links and still obtain S1 circuit performance on an end-to-end basis.	S1	3002	Basic(2) or C2 D1

1 No general offering but special arrangement can be ordered between specific locations.

2 Basic for 2400 and 4800 b/s; C2 D1 for 9600 b/s conditioning.

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254	
			CHAN. TYPE	COND.
	CATEGORY 1: USER-TO-USER CIRCUITS (CON.)			
	FACSIMILE			
1F	Facsimile transmission which can be accommodated over a voice grade channel with no special conditioning. If the required facsimile (including telephoto) service involves special conditioning of the channel, specific circuit parameters will be based on transmission means, circuit length, and characteristics of the equipment used to terminate the circuits.	V1	3002	Basic
	TELEGRAPH AND DATA			
1G	Less than 46 baud. Includes 60 wpm teletypewriter and other d.c. keying service.	N1	LS-75	
1H	46 through 75 baud. Includes 75 wpm and 100 wpm teletypewriter and other d.c. keying service.	N2	LS-75	
1J	76 through 150 baud. Includes 110 baud teletypewriter and other d.c. keying service.	N3	LD-150	
1K	Less than 46 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1L	46 through 75 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1M	76 through 150 baud. Used where d.c. keying is converted to tone on a single channel basis.	V1	3002	Basic
1N	066-068 IBM transceivers (10 to 40 cpm)	V1	3002	Basic

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254	
			CHAN. TYPE	COND.
	TELEGRAPH AND DATA (CON.)			
1P	300 through 600 baud. Includes data card or other service.	D2	LS-300 or LS-600/ 1200	
1Q	1200 baud. Includes data card or other service.	D2	3002	Basic
1R	2400 b/s; alternate voice/record service.	S1	3002	Basic
1S	4800 b/s; alternate voice/record service.	S1	3002	Basic
1T	9600 and 7200 b/s; alternate voice record service.	S1	3002	C2 D1
	CATEGORY 2: VOICE FREQUENCY CARRIER TELECRAPH (VFCT) SYSTEMS			
2A	VFCT, type 1. Up to 16 telegraph channels.	D2	3002	Basic
2B	VFCT, type 2. Up to 26 telegraph channels provided over a voice frequency channel between carrier terminals.	S1	3002	C4

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254	
			CHAN. TYPE	COND.
	CATEGORY 3: AUTOVON ACCESS LINES			
3A	Voice grade.	V2	2001	Basic
3B	Special grade, alternate voice/record access from AUTODIN switch, and 2400 through 9600 b/s secure voice access from secure voice terminals, cordboard (SECORD), SEVAC, and other secure four-wire switchboards.	S3	3002	Basic[3] or C2 D1
3C	Special grade, alternate voice/record.	S3	3002	Basic
	CATEGORY 4: AUTOVON TRUNKS			
4A	Interswitch voice grade.	V2	2001	C2
4B	Interswitch special grade, not transoceanic (no regenerators at either end).	S3	2001	C4
4C	Interswitch special grade, not transoceanic (regenerators at both ends).	S1	2001	C2
4D	Interswitch special grade, not transoceanic (regenerators at one end.	S2	2001	C4
4E	Interswitch special grade, alternate voice/record.	S3	2001	C4
4F	Loop-around, regenerative, Option 1. Regenerators located physically at the AUTOVON Switching Center.	S3	2001	C4
4G	Loop-around, regenerative, Option 2. Regenerators located physically at a remote site on Government property.	S3	2001	C4

[3] See footnote 2, page 20.

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254	
			CHAN. TYPE	COND.
	CATEGORY 5: AUTODIN ACCESS LINES			
5A	75 baud; d.c. keying.	N2	LS-75	
5B	150 baud; d.c. keying.	N3	LS-150	
5C	75 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5D	150 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5E	300 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5F	600 baud; from terminal to switch or to a bridge at a transmission nodal point, tone keying.	D2	3002	Basic
5G	1200 baud; limited to data service only.	D2	3002	Basic
5H	1200 b/s multiplexed; from a user or transmission nodal point where a VF channel is multiplexed or bridged with any compatible combination of 75-, 150-, 300-, or 600-baud modems not to exceed 1200 b/s total. VF bridging is used at transmission nodal points to serve noncollocated users.	D2	3002	Basic
5I	Not used.			
5J	2400 b/s; alternate voice/record service.	S1	3002	Basic
5K	Not used.			
5L	Not used.			

Enclosure 2

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254	
			CHAN. TYPE	COND.
	CATEGORY 5: AUTODIN ACCESS LINES (CON.)			
5M	4800 b/s; alternate voice/record service.	S1	3002	Basic
5N	Not used.			
5O	Not used.			
5P	Not used.			
5Q	9600 and 7200 b/s; alternate voice record data service.	S1	3002	C2 D1
	CATEGORY 6: AUTODIN INTERSWITCH TRUNKS			
6A	2400 b/s through 4800 b/s; dedicated circuit from one AUTODIN switch to another.	S1	3002	Basic
6B	Not used.			
6C	9600 and 7200 b/s; alternate voice/ record service.	S1	3002	C2 D1
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES			
7A	Not used.			
7B	Secure voice terminal, 2400 b/s, to four-wire JOSS or AUTOVON switch.	S3	3002	Basic
7C	Secure voice terminal, 50 kb/s baseband, to SECORD or AUTOSEVOCOM switching facility without regenerators over metallic facilities.	Z2	9000	

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254 CHAN. TYPE	WU TARIFF FCC 254 COND.
	CATEGORY 7: AUTOSEVOCOM ACCESS LINES (CON.)			
7D	Secure voice terminal, 50 kb/s baseband, to special 758 switch or cordboard (SECORD) or AN/FTC-31 over long-distance carrier facilities.	Z4	8803	
7E	Secure voice terminal, 50 kb/s baseband, to AN/FTC-31, over metallic facilities.	Z1	9000(4)	
7F	Secure voice terminal, operating at 9600 b/s to JOSS or AUTOVON switch.	S3	3002	C2 D1
	CATEGORY 8: AUTOSEVOCOM TRUNKS			
8A	50 kb/s baseband, over metallic facilities without regenerators.	Z3	9000(4)	
8B	50 kb/s baseband, over long-distance carrier facilities.	Z4	8803	
8C	Not used.			
8D	2400 b/s (JOSS to either a JOSS or a cordboard (SECORD)).	S3	3002	Basic
8E	2400 b/s (SEVAC to JOSS or 5-D switchboard).	S3	3002	Basic
8F	Interswitch trunk operating at 9600 b/s providing secure voice service. (This service is derived from the AUTOVON.)	S1	3002	C2 D1

4 See footnote 1, page 20.

Enclosure 2

TABLE 7. DCS TECHNICAL SCHEDULES FOR CIRCUITS LEASED FROM WESTERN UNION (CON.)

ITEM NO.	DESCRIPTION OF DCS SERVICE	DCS CIRCUIT PARAMETER CODE	WU TARIFF FCC 254 CHAN. TYPE	WU TARIFF FCC 254 COND.
	CATEGORY 9: 60-108 kHz BASIC GROUPS			
9A	Frequency Division Multiplexing (FDM) Use. This item should be specified whenever a DCS 60-108 kHz channel is equipped with GFE FDM equipment at DCS station locations.	X1	NA	
9B	Derivation of 50 kb/s Data Service. This item should be specified whenever a 60-108 kHz channel is required to interconnect 50 kb/s points in the DCS by use of a special GFE modem and GFE auxiliary set (such as WECO type 303 data modem and WECO type 842 data auxiliary set which provides interconnection of subscribers on a 4-kHz basis whenever the 50 kb/s signal is removed from the user's 4-wire line.) The derived service is similar to item 7D. The AN/USC-26 group data modem may also be used in deriving this service, but in the half group mode of operation the data signal level (Circuit Parameter Code X2, item k, table 2) should be reduced to -8 dBm0.	X2	8803	
	CATEGORY 10: 1.544 Mb/s BASIC DIGROUPS			
10A	Time Division Multiplexing (TDM) Use. This should be specified whenever a 1.544 Mb/s circuit is equipped with PCM equipment at DCS station locations. Generally used to derive 24 voice channels, but data channels may also be derived.	Y1	9000(5)	

5 No general offering but special arrangement can be ordered between specific locations. See also footnote 23, enclosure 2, table 1, page 13.

DCS LINK AND MULTILINK CHANNEL PERFORMANCE STANDARDS

TABLE 1. ELECTRICAL PERFORMANCE REQUIREMENTS APPLICABLE TO LINKS OR MULTILINKS WHERE OFFICIAL RECORDED DATA ARE AVAILABLE[1]

Parameter	Channel Performance Value	Permissible Deviation
a. Signal Level in VF Channel	Data and VFCT Composite Level -13 dBm0	±2 dB
	Secure Voice in data mode -13 dBm0	±2 dB
	Speech Plus-Equipped Circuits	
	Maximum Data and VFCT Composite Level -13 dBm0 or lower	Not to increase more than 2 dB
	SF Tone as Measured at Circuit Lineup	± 4 dB including ±1.5 dB source variation
b. Idle Channel Noise in VF Channel	Value based upon official acceptance of the link or multilinks, value obtained during a major realignment or data obtained as a result of the DCS Technical Visits Program	+10 dB
c. Impulse Noise in VF Channel	Same as b	+ 10 dB increase in level or 20% increase number of noise counts
d. Phase Jitter in VF Channel	Same as b	+10% increase in magnitude
e. Maximum change in Audiofrequency in VF Channel	0 Hz	±2 Hz
f. Total telegraph distortion (including components of distortion such as bias, characteristics, fortuitous, etc	Same as b	+5% increase in magnitude

[1] See paragraph 8, basic Circular.

DCS LINK AND MULTILINK CHANNEL PERFORMANCE STANDARDS

TABLE 2. ELECTRICAL PERFORMANCE REQUIREMENTS APPLICABLE TO LINKS OR MULTILINKS WHERE NO OFFICIAL RECORDED DATA ARE AVAILABLE[1]

Parameter	Channel Performance Value	Permissible Deviation
a. Composite Data or VFCT Signal Level in VF Channel	-13 dBm0	±2 dB
b. Idle VF Channel Noise for Link or Multilinks of:		
km (mi)		
0-80 (0-50)	27 dBrnC0, -61.5 dBm0	+3 dB increase
80-161 (50-100)	31 dBrnC0, -57.5 dBm0	+3 dB increase
161-644 (100-400)	34 dBrnC0, -54.5 dBm0	+3 dB increase
644-1609 (400-1000)	38 dBrnC0, -50.5 dBm0	+3 dB increase
1609-2414 (1000-1500)	40 dBrnC0, -48.5 dBm0	+3 dB increase
2414-4024 (1500-2500)	42 dBrnC0, -46.5 dBm0	+3 dB increase
4024-6438 (2500-4000)	44 dBrnC0, -44.5 dBm0	+3 dB increase
6438-12874 (4000-8000)	47 dBrnC0, -41.5 dBm0	+3 dB increase
12874-25748 (8000-16000)	50 dBrnC0, -38.5 dBm0	+3 dB increase
c. Impulse Noise in VF Channel	15 counts per 15 minutes exceeding 62 dBrnC0	+10 dB in level
d. Phase Jitter (Peak to Peak) in VF Channel	15 degrees	+1.5 degrees
e. Maximum change in Audiofrequency in VF Channel	0 Hz	±2 Hz
f. Total telegraph distortion (including components of distortion such as bias, characteristic, fortuitous, etc.) derived via broadband facilities.[2]	5%	+5%
Single VFCT derived via HF Radio Facilities	20%	+5%

[1] See paragraph 8, basic Circular.

[2] Signal regeneration should be applied when the signal distortion exceeds 25 percent.

TABLE 1. NOISE POWER CONVERSION TABLE

Pico-watts	Milli-watts	dBm	NEPERS	C-Weighting 1000 Hz dBrnC	C-Weighting 0-3kHz dBrnC	F1A 1000 Hz dBa	F1A 0-3kHz dBa	Psopho-metric 800 Hz dBm
1.0	10^{-9}	-90	-10.4	0				-89
1.3	0.13×10^{-8}	-89	-10.2	1				-88
1.6	0.16×10^{-8}	-88	-10.1	2	0			-87
2.0	0.20×10^{-8}	-87	-10.0	3	1			-86
2.5	0.25×10^{-8}	-86	-9.90	4	2			-85
3.2	0.32×10^{-8}	-85	-9.79	5	3	0		-84
4.0	0.40×10^{-8}	-84	-9.67	6	4	1		-83
5.0	0.50×10^{-8}	-83	-9.55	7	5	2		-82
6.3	0.63×10^{-8}	-82	-9.44	8	6	3	0	-81
7.9	0.80×10^{-8}	-81	-9.32	9	7	4	1	-80
10	10^{-8}	-80	-9.21	10	8	5	2	-79
1.3x10	0.13×10^{-7}	-79	-9.09	11	9	6	3	-78
1.6x10	0.16×10^{-7}	-78	-8.98	12	10	7	4	-77
2.0x10	0.20×10^{-7}	-77	-8.87	13	11	8	5	-76
2.5x10	0.25×10^{-7}	-76	-8.75	14	12	9	6	-75
3.2x10	0.32×10^{-7}	-75	-8.63	15	13	10	7	-74
4.0x10	0.40×10^{-7}	-74	-8.52	16	14	11	8	-73
5.0x10	0.50×10^{-7}	-73	-8.40	17	15	12	9	-72
6.3x10	0.63×10^{-7}	-72	-8.29	18	16	13	10	-71
7.9x10	0.80×10^{-7}	-71	-8.17	19	17	14	11	-70
10^2	10^{-7}	-70	-8.06	20	18	15	12	-69

Enclosure 4

TABLE 1. NOISE POWER CONVERSION TABLE (CON.)

Pico-watts	Milli-watts	dBm	NEPERS	Weighting C- 1000 Hz dBrnC	Weighting C- 0-3kHz dBrnC	F1A 1000 Hz dBa	F1A 0-3kHz dBa	Psopho-metric 800 Hz dBm
$1.3x10^2$	$0.13x10^{-6}$	-69	-7.94	21	19	16	13	-68
$1.6x10^2$	$0.16x10^{-6}$	-68	-7.83	22	20	17	14	-67
$2.0x10^2$	$0.20x10^{-6}$	-67	-7.71	23	21	18	15	-66
$2.5x10^2$	$0.25x10^{-6}$	-66	-7.60	24	22	19	16	-65
$3.2x10^2$	$0.32x10^{-6}$	-65	-7.48	25	23	20	17	-64
$4.0x10^2$	$0.40x10^{-6}$	-64	-7.37	26	24	21	18	-63
$5.0x10^2$	$0.50x10^{-6}$	-63	-7.25	27	25	22	19	-62
$6.3x10^2$	$0.63x10^{-6}$	-62	-7.14	28	26	23	20	-61
$7.9x10^2$	$0.80x10^{-6}$	-61	-7.02	29	27	24	21	-60
10^3	10^{-6}	-60	-6.91	30	28	25	22	-59
$1.3x10^3$	$0.13x10^{-5}$	-59	-6.79	31	29	26	23	-58
$1.6x10^3$	$0.16x10^{-5}$	-58	-6.68	32	30	27	24	-57
$2.0x10^3$	$0.20x10^{-5}$	-57	-6.56	33	31	28	25	-56
$2.5x10^3$	$0.25x10^{-5}$	-56	-6.45	34	32	29	26	-55
$3.2x10^3$	$0.32x10^{-5}$	-55	-6.33	35	33	30	27	-54
$4.0x10^3$	$0.40x10^{-5}$	-54	-6.22	36	34	31	28	-53
$5.0x10^3$	$0.50x10^{-5}$	-53	-6.10	37	35	32	29	-52
$6.3x10^3$	$0.63x10^{-5}$	-52	-5.99	38	36	33	30	-51
$7.9x10^3$	$0.80x10^{-5}$	-51	-5.87	39	37	34	31	-50
10^4	10^{-5}	-50	-5.76	40	38	35	32	-49

TABLE 1. NOISE POWER CONVERSION TABLE (CON.)

Pico-watts	Milli-watts	dBm	NEPERS	Weighting C- 1000 Hz dBrnC	Weighting C- 0-3kHz dBrnC	F1A 1000 Hz dBa	F1A 0-3kHz dBa	Psopho-metric 800 Hz dBm
$1.3x10^4$	$0.13x10^{-4}$	-49	-5.64	41	39	36	33	-48
$1.6x10^4$	$0.16x10^{-4}$	-48	-5.52	42	40	37	34	-47
$2.0x10^4$	$0.20x10^{-4}$	-47	-5.41	43	41	38	35	-46
$2.5x10^4$	$0.25x10^{-4}$	-46	-5.30	44	42	39	36	-45
$3.2x10^4$	$0.32x10^{-4}$	-45	-5.18	45	43	40	37	-44
$4.0x10^4$	$0.40x10^{-4}$	-44	-5.06	46	44	41	38	-43
$5.0x10^4$	$0.50x10^{-4}$	-43	-4.95	47	45	42	39	-42
$6.3x10^4$	$0.63x10^{-4}$	-42	-4.84	48	46	43	40	-41
$7.9x10^4$	$0.80x10^{-4}$	-41	-4.72	49	47	44	41	-40
10^5	10^{-4}	-40	-4.61	50	48	45	42	-39
$1.3x10^5$	$0.13x10^{-3}$	-39	-4.49	51	49	46	43	-38
$1.6x10^5$	$0.16x10^{-3}$	-38	-4.37	52	50	47	44	-37
$2.0x10^5$	$0.20x10^{-3}$	-37	-4.26	53	51	48	45	-36
$2.5x10^5$	$0.25x10^{-3}$	-36	-4.14	54	52	49	46	-35
$3.2x10^5$	$0.32x10^{-3}$	-35	-4.03	55	53	50	47	-34
$4.0x10^5$	$0.40x10^{-3}$	-34	-3.91	56	54	51	48	-33
$5.0x10^5$	$0.50x10^{-3}$	-33	-3.80	57	55	52	49	-32
$6.3x10^5$	$0.63x10^{-3}$	-32	-3.68	58	56	53	50	-31
$7.9x10^5$	$0.80x10^{-3}$	-31	-3.57	59	57	54	51	-30
10^6	10^{-3}	-30	-3.45	60	58	55	52	-29

TABLE 1. NOISE POWER CONVERSION TABLE (CON.)

Pico-watts	Milli-watts	dBm	NEPERS	C-Weighting 1000 Hz dBrnC	C-Weighting 0-3kHz dBrnC	F1A 1000 Hz dBa	F1A 0-3kHz dBa	Psopho-metric 800 Hz dBm
1.3×10^{6}	0.13×10^{-2}	-29	-3.34	61	59	56	53	-28
1.6×10^{6}	0.16×10^{-2}	-28	-3.22	62	60	57	54	-27
2.0×10^{6}	0.20×10^{-2}	-27	-3.11	63	61	58	55	-26
2.5×10^{6}	0.25×10^{-2}	-26	-2.99	64	62	59	56	-25
3.2×10^{6}	0.32×10^{-2}	-25	-2.88	65	63	60	57	-24
4.0×10^{6}	0.40×10^{-2}	-24	-2.76	66	64	61	58	-23
5.0×10^{6}	0.50×10^{-2}	-23	-2.65	67	65	62	59	-22
6.0×10^{6}	0.63×10^{-2}	-22	-2.53	68	66	63	60	-21
7.9×10^{6}	0.80×10^{-2}	-21	-2.42	69	67	64	61	-20
10^{7}	10^{-2}	-20	-2.30	70	68	65	62	-19
1.3×10^{7}	0.13×10^{-1}	-19	-2.19	71	69	66	63	-18
1.6×10^{7}	0.16×10^{-1}	-18	-2.07	72	70	67	64	-17
2.0×10^{7}	0.20×10^{-1}	-17	-1.96	73	71	68	65	-16
2.5×10^{7}	0.25×10^{-1}	-16	-1.84	74	72	69	66	-15
3.2×10^{7}	0.32×10^{-1}	-15	-1.73	75	73	70	67	-14
4.0×10^{7}	0.40×10^{-1}	-14	-1.61	76	74	71	68	-13
5.0×10^{7}	0.50×10^{-1}	-13	-1.50	77	75	72	69	-12
6.3×10^{7}	0.63×10^{-1}	-12	-1.38	78	76	73	70	-11
7.9×10^{7}	0.80×10^{-1}	-11	-1.27	79	77	74	71	-10
10^{8}	10^{-1}	-10	-1.15	80	78	75	72	- 9

TABLE 1. NOISE POWER CONVERSION TABLE (CONT.)

Pico-watts	Milli-watts	dBm	NEPERS	Weighting C- 1000 Hz dBrnC	Weighting C- 0-3kHz dBrnC	F1A 1000 Hz dBa	F1A 0-3kHz dBa	Psopho-metric 800 Hz dBm
1.3×10^8	0.13	-9	-1.04	81	79	76	73	-8
1.6×10^8	0.16	-8	-0.921	82	80	77	74	-7
2.0×10^8	0.20	-7	-0.806	83	81	78	75	-6
2.5×10^8	0.25	-6	-0.691	84	82	79	76	-5
3.2×10^8	0.32	-5	-0.576	85	83	80	77	-4
4.0×10^8	0.40	-4	-0.460	86	84	81	78	-3
5.0×10^8	0.50	-3	-0.345	87	85	82	79	-2
6.3×10^8	0.63	-2	-0.230	88	86	83	80	-1
7.9×10^8	0.80	-1	-0.115	89	87	84	81	0
10^9	1.0	0	0	90	88	85	82	+1

TABLE 1. STANDARD AUTOVON TELEPHONE SIGNALING TONE POWER LEVELS

	SIGNAL	COMPOSITE POWER LEVEL[1]
1.	Dial tone.[2] 350 Hz + 440 Hz mixed.	-10 dBm0 ±3 dB
2.	Dial tone. 600 Hz amplitude modulated at 120 Hz.	-18 dBm0 ±3 dB
3.	Busy tone[2] (line busy). 480 Hz + 620 Hz mixed.	-21 dBm0 ±3 dB
4.	No circuit tone[2] (trunk busy). 480 Hz + 620 Hz mixed.	-18 dBm0 ±3 dB
5.	No circuit tone (trunk busy). 600 Hz amplitude modulated at 120 Hz.	-18 dBm0 ±3 dB
6.	Busy tone (line busy). 600 Hz amplitude modulated at 120 Hz.	-18 dBm0 ±3 dB
7.	Reorder tone.[2] 480 Hz + 620 Hz mixed.	-21 dBm0 ±3 dB
8.	Audible ringing tone.[2] 440 Hz + 480 Hz mixed.	-13 dBm0 ±3 dB
9.	Audible ringing tone (ringback). 400 Hz or 420 Hz amplitude modulated at 40 Hz.	-18 dBm0 ±3 dB

[1] Measured at the input to the DCS transmission system; i.e., at the first established TLP.

[2] Indicates preferred signaling tone.

TABLE 1. STANDARD AUTOVON TELEPHONE SIGNALING TONE POWER LEVELS (CON.)

SIGNAL	COMPOSITE POWER LEVEL[1]
10. Preemption tone. 440 Hz + 620 Hz mixed.	-15 dBm0 ±3 dB
11. Conference notification tone.[2] 852 Hz + 1336 Hz alternating.	-24 dBm0 ±3 dB
12. Permanent tone. 350 Hz + 480 Hz mixed.	-14 dBm0 ±3 dB
13. Permanent tone. 600 Hz amplitude modulated at 120 Hz.	-18 dBm0 ±3 dB
14. Multifrequency (MF) signaling tones (2/6).	-3 dBm0 ±1 dB
15. Dual tone multifrequency (DTMF) tones.	-11 to -3 dBm0
16. Single frequency (SF) signaling, 2600 Hz.	
a. Pulsing.	-8 dBm0 ±1.5 dB
b. Idle.	-20 dBm0 ±1.5 dB

[1] See footnote 1, page 1.

[2] See footnote 2, page 1.

TABLE 2. STANDARD TELEPHONE SIGNALING TONE POWER LEVELS

SIGNAL	COMPOSITE POWER LEVEL[1]
1. Ringdown tones.	
a. 1000 Hz tone, amplitude modulated with 20 Hz.	-10 dBm0 ±1.5 dB
b. 1600 Hz tone, single frequency.	-10 dBm0 ±1.5 dB
c. 2300 Hz tone, frequency modulated with 69 or 240 Hz.	-10 dBm0 ±1.5 dB
d. All other ringdown tones.	Not to exceed -10 dBm0 ±1.5 dB
2. Control tone (AN/FTA-15 and AN/FTA-28), 1310 Hz function, 1225 Hz standby.	-20 dBm0 ±1.5 dB
3. Any circuit continuity or verification tone not listed elsewhere in this document or transmitted as a component of the data signal.	-20 dBm0 ±1.5 dB
4. Single frequency (SF) signaling, 2600 Hz.[2]	
a. Pulsing.	-8 dBm0 ±1.5 dB
b. Idle.	-20 dBm0 ±1.5 dB

[1] Measured at the input to the DCS transmission system; i.e., at the first established TLP.

[2] Indicates preferred signaling tones.

TABLE 3. AUTOSEVOCOM (AN/FTC-31)[1]

SUPERVISORY AND SIGNALING TONE LEVELS

FOR WIDEBAND 50 kb/s CIRCUITS AND WIDEBAND INTERSWITCH TRUNKS

SIGNAL	FREQUENCY(Hz)[2]	RATE	COMPOSITE POWER LEVEL[2,3]
Switch to Subscriber[4]			
Dial Tone	350 + 440 Hz	Steady	-15 dBm
Busy Tone	480 + 620 Hz	60 IPM	-15 dBm
Ring Forward	1000 Hz	1 sec on 3 sec off	- 6 dBm
Ringback (Audible)	1000 Hz	1 sec on 3 sec off	- 6 dBm
Preempt	800/400	Steady	-15 dBm
Data	50 kb/s	Steady	0 dBm
Subscriber to Switch[5]			
On-Hook	2600 Hz	Steady	-20 dBm[6]
Dial Pulses	2600 Hz	10 PPM 60/40 ms Break/Make	- 8 dBm
Data	50 kb/s	Steady	1.04 Vp-p
Mode I Trunk (Switch Send & Receive)[4,7]			
On-Hook (Idle)	2600 Hz	Steady	-20 dBm[6]
Off-Hook (Seizure)	Removal of 2600 Hz		
Busy Tone	480 + 620 Hz Superimposed on 2600 Hz	60 IPM	-15 dBm
Ringback (Audible)	440 + 480 Hz	1 sec on 3 sec off	-16 dBm
Answer Supervision	Removal of 2600 Hz and Ringback		

See footnote on page 5.

TABLE 3. AUTOSEVOCOM (AN/FTC-31)[1]

SUPERVISORY AND SIGNALING TONE LEVELS

FOR WIDEBAND 50 kb/s CIRCUITS AND WIDEBAND INTERSWITCH TRUNKS (CON.)

SIGNAL	FREQUENCY(Hz)[2]	RATE	COMPOSITE POWER LEVEL[3]
	Mode I Trunk (Switch Send & Receive) (Con.)[4,7]		
Preempt	2600 Hz "wink" sequence		
Dial Pulses	2600 Hz	60/40 ms Break/Make	- 8 dBm
Data	50 kb/s	Steady	1.04 Vp-p
MF 2/6 Signaling	CCITT 2/6 Specification		
D.P. Stop Dial	Transition from on-hook to off-hook		
D.P. Start Dial	D.P. stop dial followed by transition from off-hook to on-hook		- 8 dBm

[1] For system configuration diagram see TM 11-5805-620-14/NAVELEX 0967-426-9010/TO 31W1-1-481.

[2] The frequency tolerance that can be expected will be ± 1 percent of the nominal value with the levels having a long-term variation of ± 3 dB from the stated value.

[3] Allowable long-term variation is ± 3 dB.

[4] Measured at output of switch.

[5] Measured at output of subscriber's terminal device: This level as measured at input of switch will be reduced by allowable loss for Z2 Circuits.

[6] In the transition from off-hook to idle the 20 dBm idle signal is preceded by a 250 millisecond burst of 2600 Hz at -9 dBm.

[7] Mode I trunks are utilized as interswitch trunks (IST's) between AN/FTC-31's and/or other automatic wideband switches of the AUTOSEVOCOM. (Mode II trunks are utilized between an AN/FTC-31 and its associated SEVAC.)