J99343GS 2-2 WIRE UNIVERSAL ADAPTIVE REPEATER/ LOOP SIGNALING REPEATER COMBINED FUNCTION UNIT—DESCRIPTION METALLIC FACILITY TERMINAL

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1. GENERAL

1.01 This practice provides a physical description and describes the basic functions of the J99343GS 2-2 Wire Universal Adaptive Repeater/ Loop Signaling Repeater Combined Function Unit. Transmission performance, typical applications, and maintenance philosophy are also discussed. The transmission part of the J99343GS CFU (combined function unit) features a new system that continuously monitors and automatically balances each facility interface with the repeater.

1.02 When this practice is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 The MFT (metallic facility terminal) is a standard equipment arrangement for providing various transmission and/or signaling functions that may be required by metallic facilities. The J99343GS CFU is an MFT plug-in that consists of a component board held by a molded polycarbonate frame. The J99343GS CFU, which is shown in Fig. 1, measures 1-11/16 inches wide, 7-7/8 inches high, and 9 inches deep.

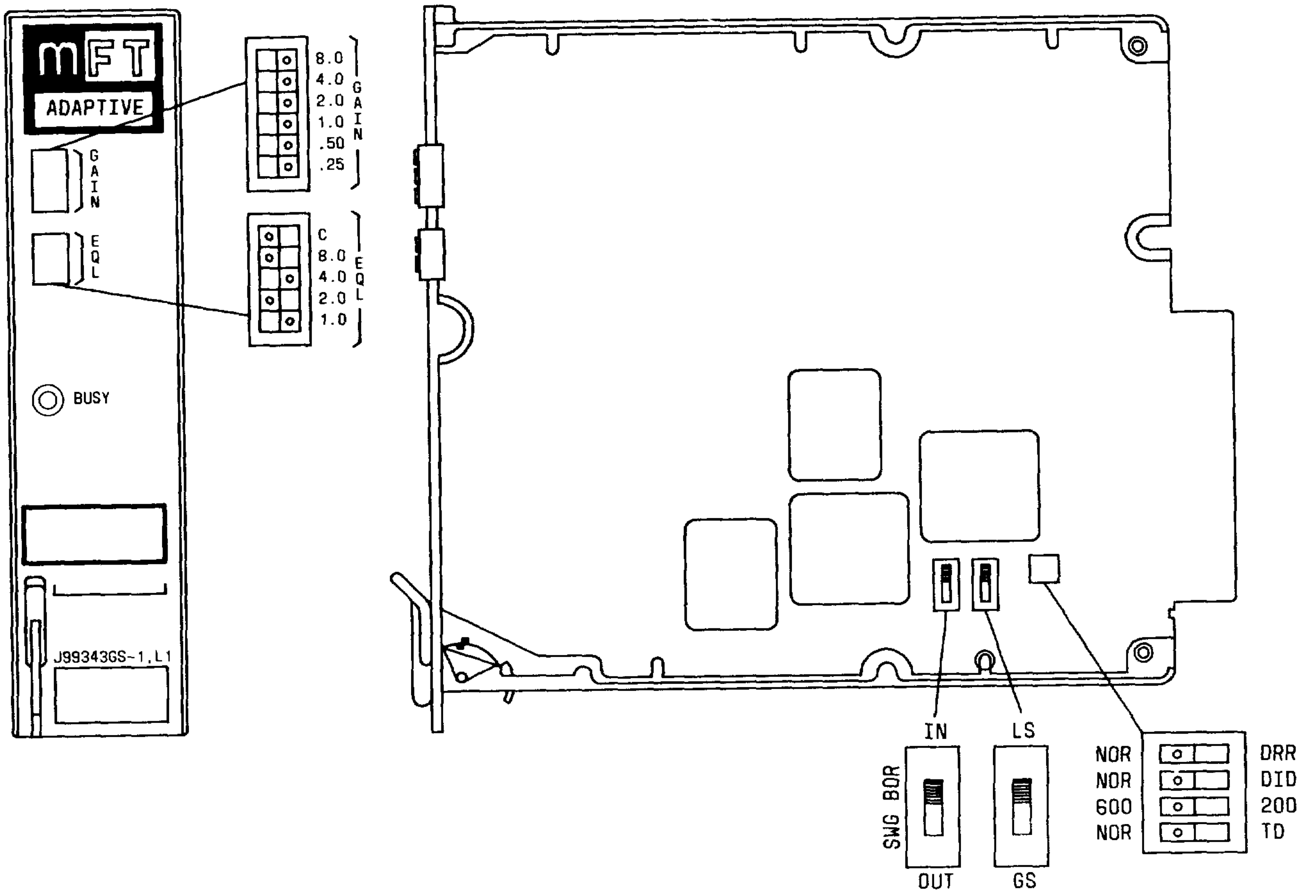


Fig. 1—J99343GS 2-2 Wire CFU—Component Layout

1.04 The features and physical criteria of the J99343GS CFU are designed to the same format as current MFT repeaters. This allows the J99343GS CFU to be integrated gracefully into a customer's existing administrative and circuit design systems. The J99343GS CFU combines the functions of a transmission unit and a signaling unit on a single MFT plug-in. It can be used in either a single- or double-module mounting arrangement. It can be mounted in any slot of a single-module shelf. When this CFU is used in the double-module arrangement, it is mounted in the transmission unit slot. The companion signaling unit must be left vacant. Section 332-910-101 contains additional information on MFT mounting arrangements.

1.05 The J99343GS CFU provides continuous automatic balancing for both directions of transmission on loaded or nonloaded cable using digital techniques. The gain and equalization for both directions of transmission are adjusted manually using controls that interface with the digital electronics of the repeater.

1.06 The J99343GS CFU provides the functions of the J99343AJ LSR (loop signaling repeater) and the J99343PR universal adaptive repeater. Detailed installation and test information for this CFU can be found in AT&T Practice 332-912-265.

2. FUNCTIONAL DESCRIPTION

A. General

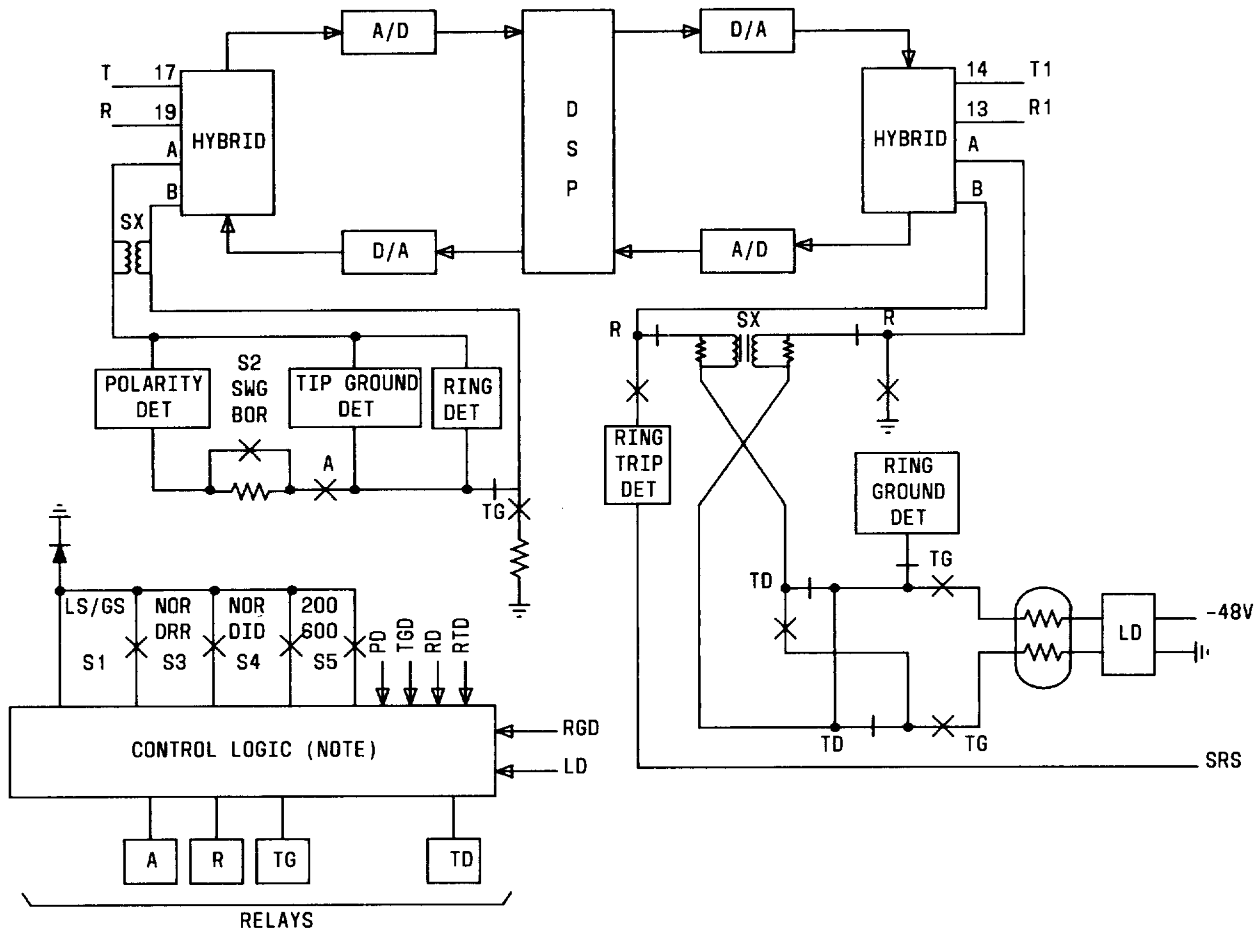
Transmission

2.01 Former methods for 2-2 wire repeaters to provide gain and equalization while controlling echo were accomplished through precision balance networks using hybrid-type transformers. Once the adjustments for the hybrid transformers were set, they remained fixed regardless of any cable changes due to time, temperature, etc. In many cases, the cable changes could cause singing and/or crosstalk.

2.02 A block diagram of the J99343GS CFU is shown in Fig. 2. This CFU provides continuous automatic balancing techniques which are used to cancel the return echo signal regardless of the line condition or impedance changes. To accomplish this feature, the input analog signals are converted to digital signals which are analyzed by a DSP (digital signal processor). Unique software is programmed into the DSP to do gain, equalization, and echo canceling.

Signaling

2.03 The signaling section of this unit provides regeneration of all signals required for loop-start and ground-start operation including normal and distinctive ringing. Additional functions included in the signaling section are dial-pulse correc-



NOTE: THE CONTROL LOGIC SECTION PROVIDES CIRCUITRY FOR:

- LOOP-START/GROUND-START OPERATION
- LOOP CLOSURE DETECTOR AND PULSE CORRECTION
- RINGING DETECTOR CIRCUITS
- OPEN SWITCHING INTERVAL PROTECTION
- FORWARD DISCONNECT
- BATTERY REVERSALS
- DIRECT INWARD DIALING

Fig. 2—J99343GS 2-2 Wire CFU—Block Diagram

tion, ringing regeneration, toll diversion, DID (direct inward dialing) capability, open switching interval protection, forward disconnect, and ring-trip during silent and ringing intervals.

B. Operation

Transmission

2.04 The J99343GS CFU can be used to furnish gain and equalization between 2-wire loaded/ nonloaded cable facilities in intermediate applications or between terminal equipment and loaded/ nonloaded facilities in terminal applications. The main transmission circuits for this unit are as follows:

- Digital Circuits
- Analog Circuit
- Power Supply Circuit.

2.05 ***Digital Circuits:*** The digital circuitry consists of a single RAM DSP, two μ-law codecs with parallel logic inputs, a 10.24-MHz DSP clock, and a 4.096-MHz codec clock.

2.06 The DSP is a high-speed specialized microcomputer. Under program control it provides gain, equalization, and automatic echo canceling in the J99343GS CFU for both the A- and B-side facility interface. This microcomputer incorporates greater speed, less cost, and more reliability than conventional analog electronics.

2.07 The codecs function to connect the DSP to the inputs and outputs of the analog circuits. Two converters are used in the codecs to convert analog signals to digital signals and digital signals to analog signals.

2.08 The 10.24- and 4.096-MHz clocks are required for timing functions between the associated digital circuits.

2.09 The use of an opto isolator for large signal detection is incorporated into the J99343GS CFU. The presence of large signals, such as ringing and dial pulsing, is sensed and transmitted to the DSP which freezes the adjustments to the echo cancelers. This allows the echo cancelers to function properly in the presence of corrupting signals.

2.10 ***Analog Circuit:*** The input and output analog circuit components for the A- and B-sides of the J99343GS CFU are identical. However, variations in circuit components and signals do exist in the dc signaling area.

2.11 The analog transmission section on the A- and B-side of the J99343GS CFU consists mainly of a 2-wire coupling transformer with op-amp drivers for passing signals between the cable facility and the codecs described in paragraph 2.06.

2.12 Adjustable gain and equalization are provided for both directions of transmission. The controls for gain and equalization are designated GAIN and EQL, respectively. The range of the amplifier unit gain is 0 to 15.75 dB. Additional gain is provided by the adjustable equalizer.

> ***Note:*** For cable crosstalk considerations, the maximum gain is typically limited to 12 dB for intermediate repeaters and 6 dB for terminal repeaters.

2.13 ***Power Supply Circuit:*** Due to the design requirements of the J99343GS CFU, a power supply different from most standard MFT designs is required. The voltages are listed as follows:

- +9 and −19 volts with current capabilities of 25 mA
- −10 volts capable of delivering 25 mA
- −5 volts supply capable of driving a 300-mA load.

Switching transients in all the supplies are filtered using RC filters.

Signaling

2.14 The principal functions of the LSR portion of the J99343GS CFU, shown in Fig. 2, are as follows:

(a) Loop-start or ground-start mode

(b) Loop-closure detection and pulse correction

(c) Ring detector

(d) Ring-trip detector

(e) Open-switching interval protection

(f) Forward disconnect

(g) Battery reversals

(h) DID capability

(i) Switch-side BOR (build-out resistor).

2.15 ***Loop-Start or Ground-Start Mode:*** Loop-start or ground-start mode may be selected as required by circuit application. The mode of operation is selected by placing the LS-GS switch in the desired position.

2.16 ***Loop-Closure Detector and Pulse Correction:*** The loop-closure detector detects switch-hook signals and dial pulses from the station-side equipment and transmits these signals to the logic circuitry. The logic circuitry includes a pulse corrector which repeats corrected dial signals toward the switching equipment. A resistance lamp provides current-limiting on the station-side loop.

2.17 ***Ring Detector:*** The ring detector senses ringing signals on the A-side of the unit and connects a local ringing source to the station-side (B-side) loop. The ringing detector operates in two modes, the normal mode and the distinctive-ringing reject mode. The selection of the modes is controlled by the NOR/DRR switch.

2.18 ***Ring-Trip Detector:*** The ring-trip detector detects station off-hook signals during the ringing interval and causes a loop closure by transmitting a ring-trip signal toward the switching equipment. The ring-trip signal also causes the local ringing to be removed from the station loop. During the silent interval, the station off-hook signals are detected by the loop-closure detector causing the local ringing circuitry to be tripped.

2.19 ***Open-Switching Interval Protection:*** To prevent normal A-side open intervals from being interpreted as forward disconnect signals, open-switching interval protection is provided. The duration of the open-interval protection (200 ms or 600 ms) is selected by the setting of the 200-600 switch.

2.20 ***Forward Disconnect:*** The J99343GS CFU will forward disconnect in the loop-start and ground-start mode of operation. Switching-side open intervals longer than the selected 200 or 600 ms of open-switching interval protection are interpreted as forward-disconnect signals. Upon detection of a forward-disconnect signal, the tip conductor will be opened toward the station. If the J99343GS CFU is in the ground-start mode, the trunk circuit will be released and the CFU will return to the idle ground-start state. If the J99343GS CFU is in the loop-start mode, the station loop will be opened for 850 ms. After this 850-ms interval, the CFU will return to the idle loop-start state.

2.21 ***Battery Reversals:*** The J99343GS CFU will detect steady state and wink reverse battery signaling and repeat them on the station side of the unit. This feature is controlled by the NOR-TD switch.

2.22 ***Direct Inward Dialing:*** The J99343GS CFU may be used on DID circuits when the NOR-DID switch is in the DID position. The J99343GS CFU may be used with loop and battery-ground outpulsing as well as with either immediate-start, delay-dial, or wink-start dial-pulse supervision. The NOR position is used for circuit applications not requiring DID compatibility.

2.23 ***Switch-Side BOR:*** A selectable BOR is provided in the switching-side circuitry to limit the loop current on short loops. The selectable switch is designated SWG BOR (IN-OUT).

C. Unit Controls

Transmission

2.24 Continuous automatic balancing for loaded/nonloaded cable and equipment interfaces is provided by the new design techniques of the J99343GS CFU. Manual balancing controls are not required for this CFU.

2.25 Gain and equalization for both directions of transmission are set manually using slide-type switches. These switches are operated when moved toward their respective designation. The sum of the values of the switches operated is the setting for that function. These switches are described in the following paragraphs.

2.26 ***GAIN:*** Six miniature switches, labeled GAIN, control the gain of the repeater. The

GAIN switches, accessible through the front faceplate, are individually designated 8.0, 4.0, 2.0, 1.0, .50, and .25 (dB). These switches provide the same gain in both directions of transmission simultaneously.

2.27 ***EQL:*** Five slide switches, labeled EQL and individually designated C, 8, 4, 2, and 1, adjust the equalization for both directions of transmission simultaneously. The C switch acts as a range selector and, when operated toward the designation, introduces a steeper degree of equalization or slope across the voiceband. The other four numerical switches (8, 4, 2, 1) allow selection of 16 different equalizer shapes for each position of the C switch. The operated sum of the values of the numerical switches and the C-switch position determine the equalization. See Section 332-912-212 for prescription settings of the equalization switches.

Signaling

2.28 The J99343GS CFU unit signaling controls, described briefly in the following paragraphs, are illustrated in Fig. 1.

2.29 ***LS/GS:*** The LS/GS switch is set based on the interfacing circuit arrangement. The LS position is used when the circuit is arranged for a loop-start operation. The GS position is used when the circuit is arranged for a ground-start operation.

2.30 ***NOR/DRR:*** The ringing circuitry is controlled by the NOR/DRR switch. In the NOR position, "ring-ping" signals and all distinctive ringing patterns will be reproduced. In the DRR mode, ringing patterns less than 170 ms in duration are rejected (no local ringing output). A ringing signal greater than 170 ms produces a 2-second ringing output. The DRR mode converts all distinctive ringing patterns into the 2-second ringing output and rejects "ring-ping" signals. Therefore, the unit can be used with other equipment that cannot pass distinctive ringing patterns.

> ***Note:*** Accurate reproduction of the distinctive ringing patterns in tandem arrangements cannot be guaranteed.

2.31 ***200-600:*** The duration of the open-switching interval protection is selected by setting this switch. In the 200 position, 200 ms of open-interval protection is provided. The 200-ms option should be selected if the switching equipment is a step-by-step central office. The 200-ms option is also recommended for some of the signaling units in a tandem LSR arrangement. It is recommended that 600 ms of open-interval protection be selected for the LSR nearest the switching equipment. The remaining units in the tandem arrangement should select 200 ms of protection. For most other applications, 600 ms of open-interval protection is recommended.

2.32 ***NOR-TD:*** This switch controls the regeneration of battery reversal signals for switching equipment (e.g., toll diversion). In the TD position, all battery reversals greater than 50 ms received from the switching equipment will be regenerated and transmitted toward the station. In the NOR position, battery reversals are blocked and not passed to the station equipment.

2.33 ***NOR-DID:*** This switch provides optional compatibility with DID. A nominal-station seizure delay of 150 ms is provided when the switch is in the NOR position. A 50-ms station seizure delay is provided when the switch is in the DID position for compatibility with delay-dial and immediate-start supervision used on DID circuits.

2.34 ***SWG BOR (IN-OUT):*** The switching-side BOR is provided to limit the switching-side loop current on short loops. The BOR is inserted in the A-side circuitry when the SWG BOR switch is in the IN position and is removed from the circuit when the SWG BOR switch is in the OUT position.

3. PERFORMANCE CHARACTERISTICS

3.01 The performance of the J99343GS CFU is discussed in the following paragraphs. Table A gives a summary of the general characteristics for this CFU.

A. Amplifier/Equalizer Frequency Response

3.02 Figures 3 and 4 give the frequency response for various equalizer and gain settings. Figure 3 provides the response curves for various equalizer settings with the C switch set for 0 (off). Figure 4 provides curves for the same equalizer settings with the C switch set for 1 (operated).

> ***Note:*** Equalizer settings are normally shown as two numbers separated by a comma. The first number is either 0 (off) or 1 (on) for the C-switch setting. The second number is the sum of the numerical switches in the equalizer switch group.

TABLE A J99343GS CFU CHARACTERISTICS	
REPEATER GAIN	0 to 15.75 dB in 0.25 dB Steps
EQUALIZER GAIN	Adjustable
MAXIMUM UNDISTORTED OUTPUT POWER	6 dBm
FACILITY INTERFACE IMPEDANCE	600 or 900 Ohms (Adjusted Automatically)
CURRENT DRAIN (mA)	Range: 55-78 mA Idle: 78 mA Off Hook: 78 mA
DIAL PULSING	7.5 to 12 pps 30 to 80 Percent Break Corrected to 60 Percent
RINGING	NOR: Normal and Distinctive Ringing Regeneration DRR: Normal Ringing Regeneration and Distinctivie Ringing Reject
SIGNALING FEATURES	Loop-Start, Ground-Start, Toll Diversion, Dial-Pulse Correction, Ring-Trip During Silent and Ringing Intervals, Open-Switching Interval Protection, DID, Forward Disconnect, and Ringing Regeneration

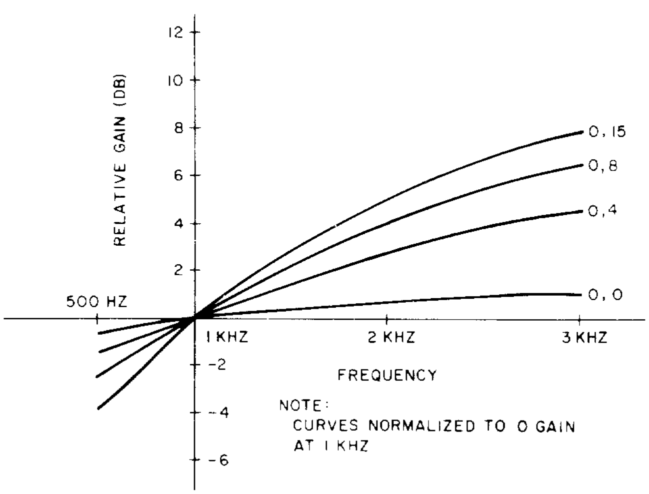


Fig. 3—Equalizer Frequency Response With C=0 (off)

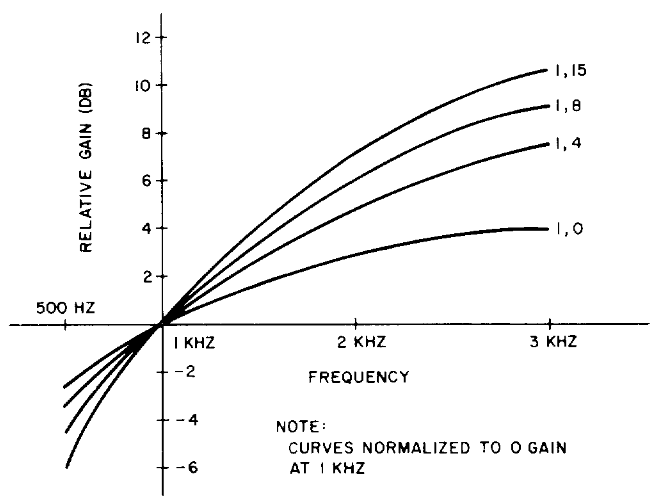


Fig. 4—Equalizer Frequency Response With C=1 (on)

B. Longitudinal Balance

3.03 The longitudinal balance for the J99343GS CFU is at least 60 dB from 200 Hz to 3000 Hz.

C. Output Power Capability

3.04 Figure 5 shows the output power capability of the J99343GS CFU. The output power is determined by input power and CFU gain. Power limiting occurs in this unit at about 6 dBm.

4. APPLICATIONS

4.01 The J99343GS CFU is designed to be a substitute for the J99343G( ) type CFUs with an LSR for the signaling arrangement. The CFU may also substitute for a double-module arrangement of a J99343P( ) repeater with an LSO (loop signaling only) or LSR signaling unit. Modification or wiring changes of the MFT bay will not be required for the J99343GS CFU.

4.02 The two wire ports of the J99343GS 2-2 wire CFU will interface with loaded or nonloaded cable, 600 ohm 2-wire switches or equipment, and 900 ohm 2-wire switches or equipment. It can interface with 19, 22, 24, 25, or 26 gauge nonloaded or H88 loaded cable facilities with central office end sections between 1.5 kft and 4.5 kft and customer end sections between 3 kft and 9 kft including bridged tap. No bridge tap is permitted between loading coils or at the central office end section.

4.03 The signaling section of the J99343GS CFU extends the loop signaling range by regeneration of all signals required for loop-start and ground-start signaling. Table B illustrates the regenerated ringing range for this LSR. Table C shows the station-side supervision and dial-pulse range. Table D shows the acceptable ranges between the switch and the CFU.

5. MAINTENANCE

5.01 The MFT CFUs require no routine maintenance. If the MFT unit is determined to be faulty, it should be removed from service and replaced with a spare. The defective unit should be sent to the nearest service center for repair.

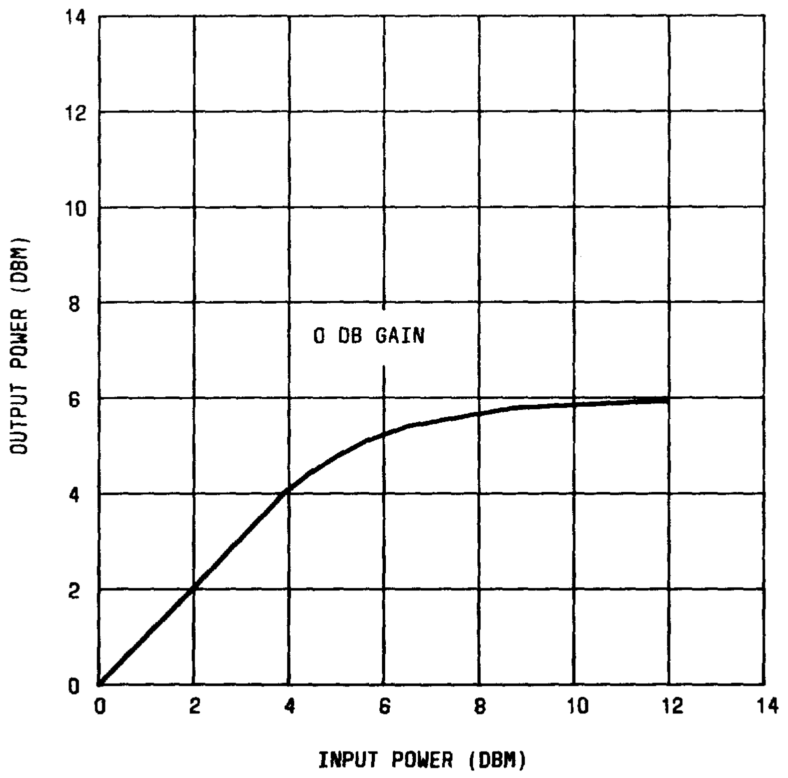


Fig. 5—Output Power Characteristics Curve

TABLE B

REGENERATED RINGING RANGES (NOTE 1)

	RINGING LOAD			
	1 PBX RINGING DETECTOR (NOTE 2)	THREE C4A RINGERS (NOTE 3)	FOUR C4A RINGERS (NOTE 3)	FIVE C4A RINGERS (NOTE 3)
Maximum resistance between LSR and ringing load	3600 ohms maximum	2600 ohms maximum	1600 ohms maximum	1200 ohms maximum

Notes:

1. Regenerated ringing ranges assume a 20-Hz ringing source of 84 to 88 volts RMS and a series 13L resistance lamp.

2. Ringing ranges to a PBX are based on typical PBX relay detectors such as the circuits used in SD-5E016 and SD-1E340.

3. Ringing ranges to station sets with C4A ringers assume a series 0.5 μF capacitor and a weak notch setting.

TABLE C

STATION-SIDE SUPERVISION AND DIAL-PULSE RANGES (NOTES 1 AND 2)

TALK BATTERY	LSR RANGE 23 MA MINIMUM LOOP CURRENT	LSR RANGE 20 MA MINIMUM LOOP CURRENT	TANDEM LSR RANGE 16 MA MINIMUM LOOP CURRENT
−42.5	1300 ohms	1450 ohms	2100 ohms
−48	1500 ohms	1750 ohms	2500 ohms
−52	1700 ohms	1950 ohms	2700 ohms
−67.5	2300 ohms	2600 ohms	3700 ohms
−72	2600 ohms	2900 ohms	4000 ohms
−78	2800 ohms	3100 ohms	4300 ohms

Notes:

1. For loop-start circuits, the station-side signaling range is limited by either the loop supervision and dial-pulse range or by the regenerated ringing range. In ground-start applications, the station-side signaling range may be limited by the station equipment tip ground supervision range.

2. The supervision and dial-pulse range includes resistance of a tandem repeater and assumes an internal resistance of 185 ohms.

TABLE D

RANGES BETWEEN SWITCH AND CFU (NOTES 1, 2, AND 3)

SWITCHING MACHINE TALK-BATTERY	TOTAL EXTERNAL CONDUCTOR RESISTANCE BETWEEN SWITCH AND CFU
−42.5	C. O. or PBX limit minus 185 ohms* or 2000 ohms maximum†
−48	C. O. or PBX limit minus 185 ohms* or 2200 ohms maximum†
−52.5	C. O. or PBX limit minus 185 ohms* or 2500 ohms maximum†

Notes:

1. The signaling range between the switching machine and the CFU is limited by the dc supervision and dial-pulse range. The 20-Hz ringing range between the switching machine and the CFU exceeds 4000 ohms.

2. The switching equipment is assumed to have a 400-ohm source resistance.

3. These ranges apply to all standard types of C. O. or PBX switching machines.

* These resistance values represent the internal resistance of the CFU with the SWG BOR switch in the OUT position.

† The maximum ranges are based on 16 milliamperes of loop current. If higher loop current is desired, appropriate ranges should be calculated based on the switch talk-battery voltage and source resistance and the internal resistance of the CFU.