

**J99343GR 2-2 WIRE UNIVERSAL ADAPTIVE REPEATER/
LOOP SIGNALING EXTENDER
COMBINED FUNCTION UNIT—DESCRIPTION
METALLIC FACILITY TERMINAL**

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3. PERFORMANCE CHARACTERISTICS	6	1.01 This practice provides a physical description and describes the basic functions of the J99343GR 2-2 Wire Universal Adaptive Repeater/ Loop Signaling Extender Combined Function Unit. Transmission performance, typical applications, and maintenance philosophy are also discussed. The J99343GR CFU (combined function unit) features a new system that continuously monitors and auto- matically balances each facility interface with the repeater.	
A. Amplifier/Equalizer Frequency Re- sponse	6	1.02 When this practice is reissued, the reason(s) for reissue will be listed in this paragraph.	
B. Longitudinal Balance	7	1.03 The MFT (metallic facility terminal) is a stan- dard equipment arrangement for providing various transmission and/or signaling functions that may be required by metallic facilities. The J99343GR CFU is an MFT plug-in that consists of a component board held by a molded polycarbonate frame. The GR CFU, which is shown in Fig. 1, measures 1-11/16 inches wide, 7-7/8 inches high, and 9 inches deep.	
C. Output Power Capability	7	1.04 The features and physical criteria of the J99343GR CFU are designed to the same for- mat as current MFT repeaters. This allows the GR repeater to be integrated gracefully into a customer's existing administrative and circuit design systems.	
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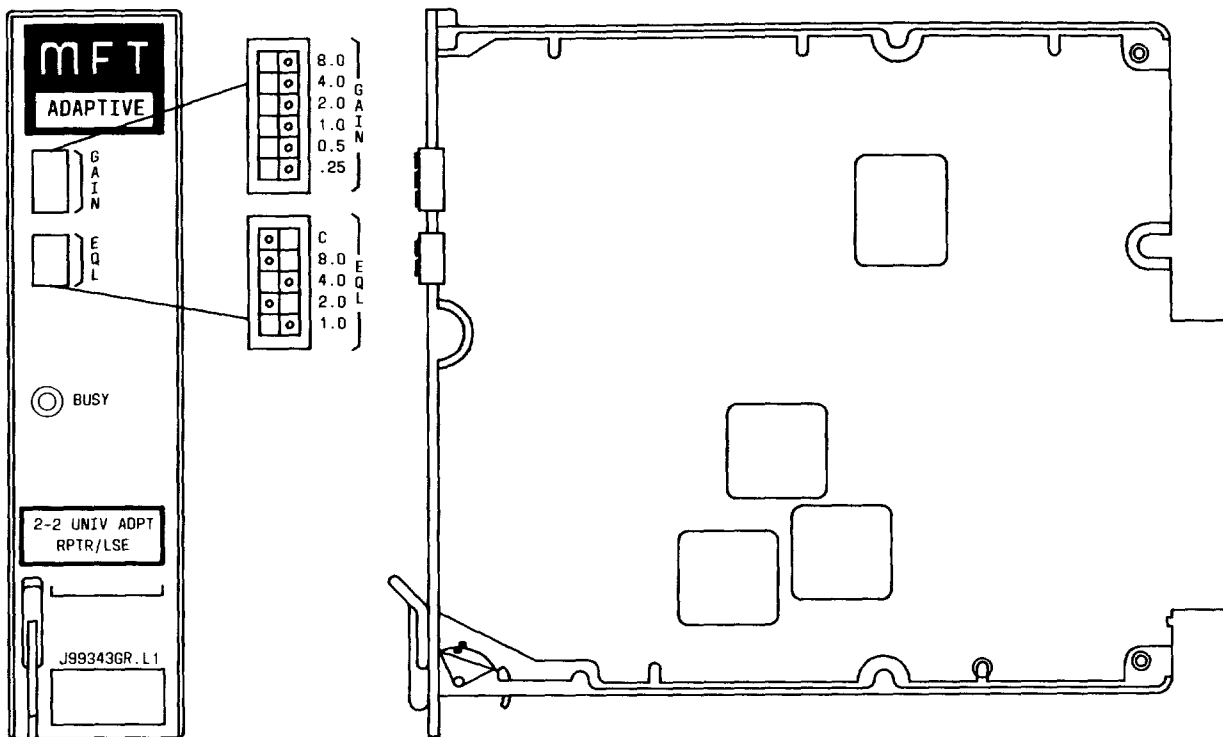


Fig. 1—J99343GR 2-2 Wire CFU—Component Layout

The J99343GR 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 GR 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 J99343GR CFU provides the functions of the J99343CE LSE (loop signaling extender) and the J99343PR universal adaptive repeater. Detailed installation and test information for this repeater can be found in Section 332-912-264.

2. FUNCTIONAL DESCRIPTION

A. General

Transmission

2.01 Previous 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 J99343GR CFU which interfaces analog with digital electronic circuitry 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 sig-

nal processor). Unique software is programmed into the DSP to do gain, equalization, and echo canceling.

Signaling

2.03 The signaling section of the unit provides signaling range extension by:

- Boosting all dc signaling voltages for signaling range extension by maintaining a floating dc potential of up to 12 volts, which can be inserted in series with each of the tip and ring conductors

- Sensing the loop current direction and maintaining the polarities of the floating boost voltages so that they always aid the CO battery.

B. Operation

Transmission

2.04 The J99343GR 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

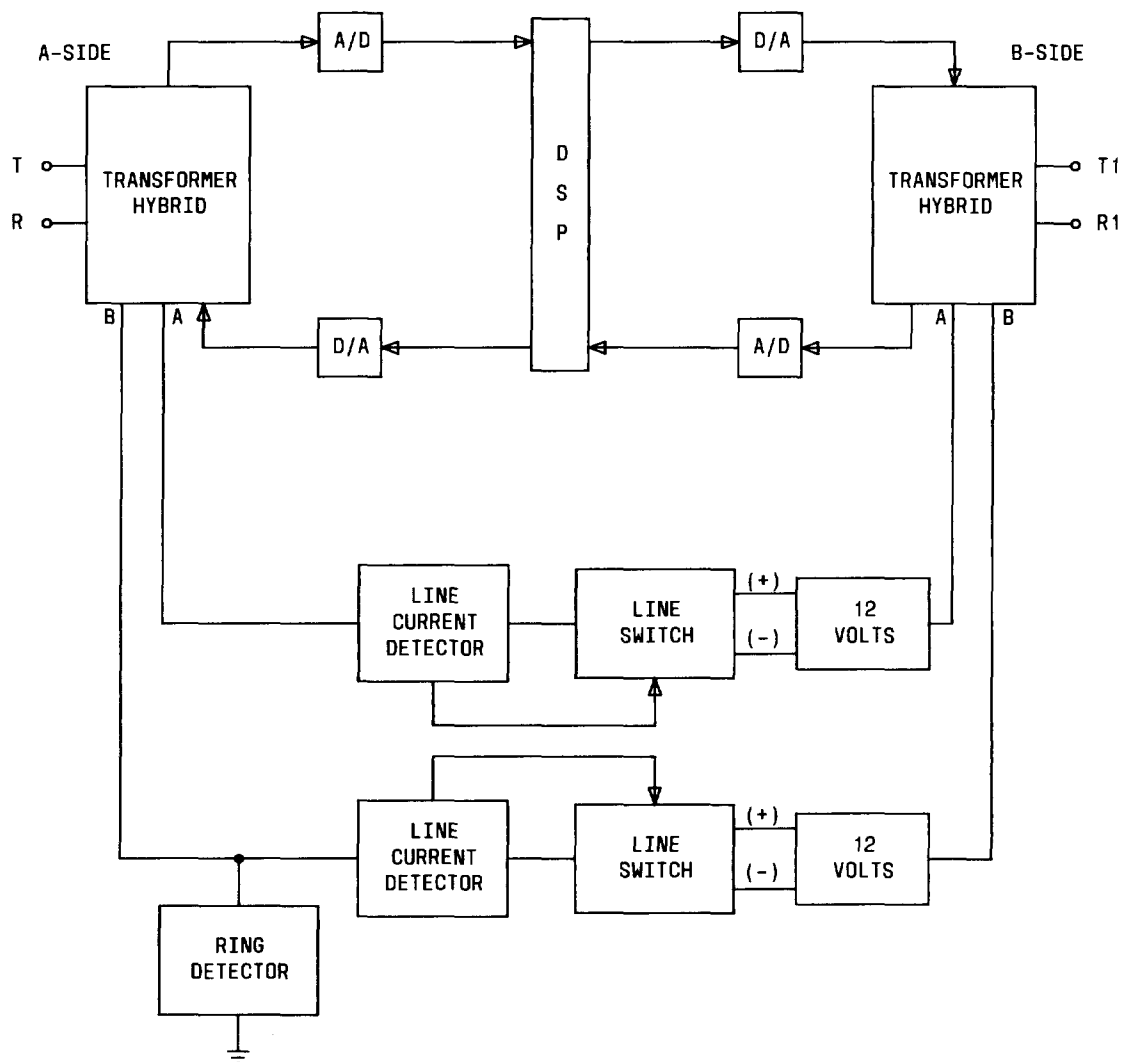


Fig. 2—J99343GR 2-2 Wire CFU—Block Diagram

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, a 4.096-MHz codec clock, a TTL inverter package, a D flip-flop, and a divide by five circuit.

2.06 The DSP is a high-speed specialized micro-computer. Under program control it provides gain, equalization, and automatic echo canceling in the GR 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 and digital signals to analog.

2.08 The 10.24-MHz and 4.096-MHz clocks, inverter, and flip-flop packages 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 J99343GR 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 J99343GR CFU are identical because the standard circuits required to balance a cable facility, which are usually different, are not required. 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 J99343GR 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 2.07.

2.12 Adjustable gain and equalization are provided for each direction 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 J99343GR CFU, a power supply different from most standard MFT designs was 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 five principal parts of the LSE portion of the J99343GR CFU, shown in Fig. 2, are as follows:

- Line current detector circuits
- 12-volt supplies and current regulator
- Line switch control circuit
- Ringing detector circuit.

2.15 *Line Current Detector Circuits:* The LSE uses optical isolators as loop-current detectors. These devices allow complete isolation between tip and ring conductors, the control circuitry, and power sources.

2.16 Line current detectors (optical isolators) are located in both the tip and ring circuits to detect ground-start or loop-start. A current of 5 mA or more of either polarity in the tip or ring circuits will operate the appropriate line current detector(s). Op-

eration of a line current detector enables the 12-volt power supplies and the appropriate line switches to supply boost voltage of the correct polarity (aiding) to the tip and ring circuits.

2.17 12-Volt Supplies and Current Regulator:

The 12-volt dc supplies for boost voltages are derived from a dc-to-dc converter source which is powered by -48 volt battery. The current regulation of the supplies is such that if the loop current increases for any reason (e.g., a decrease in loop resistance) the boost voltage decreases. This tends to prevent excessive loop currents and to help stabilize the circuit from the effects of external influences.

2.18 One of the floating dc supplies is in series with the tip and the other in series with the ring. This arrangement helps maintain longitudinal balance.

2.19 Line Switch Control Circuit: The line switch control circuit, when enabled by the line current detectors, turns on the appropriate line switch to boost the loop current. Included in the line switch control circuit is a delay circuit which will prevent the LSE portion from following battery reversals of less than 20 ms.

2.20 Ringing Detector Circuit: When ringing is detected on the A-side, the line switch is prevented from operating in the reverse direction. During a ringing cycle, the boost voltage is applied only in the normal direction. The ringing supply is assumed to be -48 volt superimposed ringing applied to the ring conductor. In this configuration the dc component of the superimposed ringing signal is

boosted assuring sufficient ring trip current during the ringing interval. The ringing characteristics of the LSE as used with various ringing signal sources are shown in Table A.

C. Unit Controls

Transmission

2.21 Continuous automatic balancing for loaded and nonloaded cable, which takes into consideration line condition or impedance changes of the cable facility, is provided by the new design techniques of the J99343GR CFU. Manual balancing controls are not required for this CFU.

2.22 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.

2.23 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.

2.24 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, intro-

TABLE A		
RINGING CHARACTERISTICS OF J99343GR CFU (LSE CIRCUIT)		
RINGING	RING-TRIP BOOST DURING RINGING	RING-TRIP BOOST DURING SILENT INTERVAL
-48 Volt Superimposed On Ring On Tip	Yes No	Yes Yes
-48 Volt Superimposed Ringing Ring to Gnd Ringing Tip to Gnd	Yes No	Yes Yes

duces a steeper degree of equalization or slope across the voiceband. The other four numerical switches (1, 2, 4, 8) 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

2.25 The J99343GR CFU does not contain manual signaling controls.

3. PERFORMANCE CHARACTERISTICS

3.01 The performance of the J99343GR CFU is discussed in the following paragraphs. Table B 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.

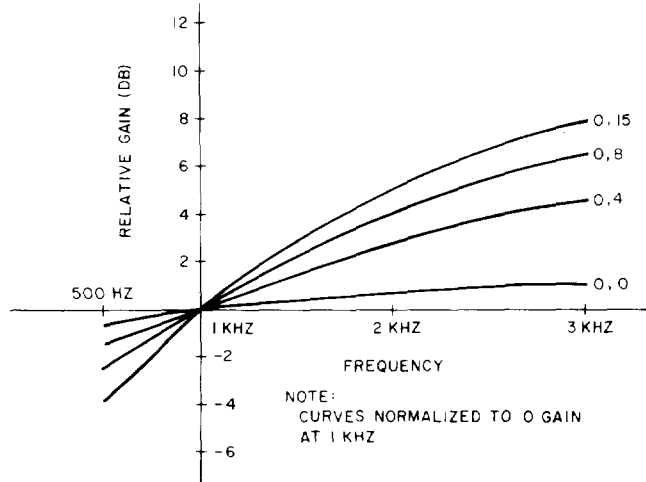


Fig. 3—Equalizer Frequency Response With C=0 (off)

TABLE B	
J99343GR CFU CHARACTERISTICS	
Repeater Gain	0 to 15.75 dB in 0.25 dB Steps
Equalizer Gain	Adjustable
Max. Undistorted Output Power	9 dBm
Interface Impedance	600 or 900 Ohms (Adjusted Automatically)
Current Drain (mA)	Range: 70--110 mA Idle Condition: 70 mA Off-Hook: 110 mA
Boost Voltage	Up to ± 24 V dc
Toll Diversion	Wink or Steady

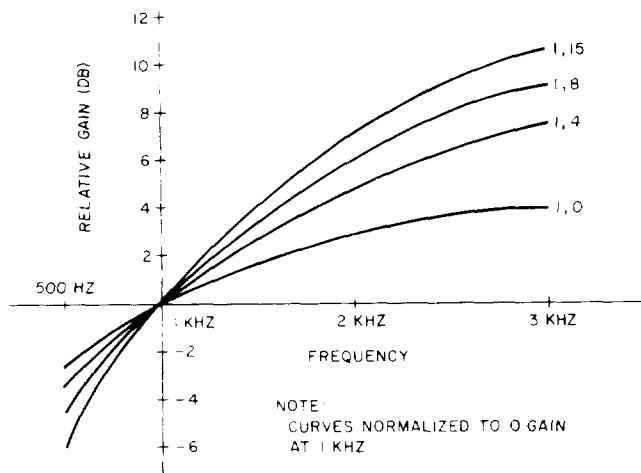


Fig. 4—Equalizer Frequency Response With C=1 (on)

B. Longitudinal Balance

3.03 The longitudinal balance for the J99343GR 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 J99343GR 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 J99343GR CFU is designed to be a substitute for the J99343GB and GE CFUs. Modification or wiring changes of the MFT bay will not be required for the GR CFU.

4.02 The two wire ports of the GR 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 J99343GR CFU provides a 12-volt battery boost in both tip and ring conductors enabling signaling range to be extended to 3000 ohms total loop resistance. Both wink and steady-state battery reversals are repeated. Ring-trip voltage is boosted for -48 volt superimposed ringing applied to the ring conductor.

5. MAINTENANCE

5.01 The MFT combined function units 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.

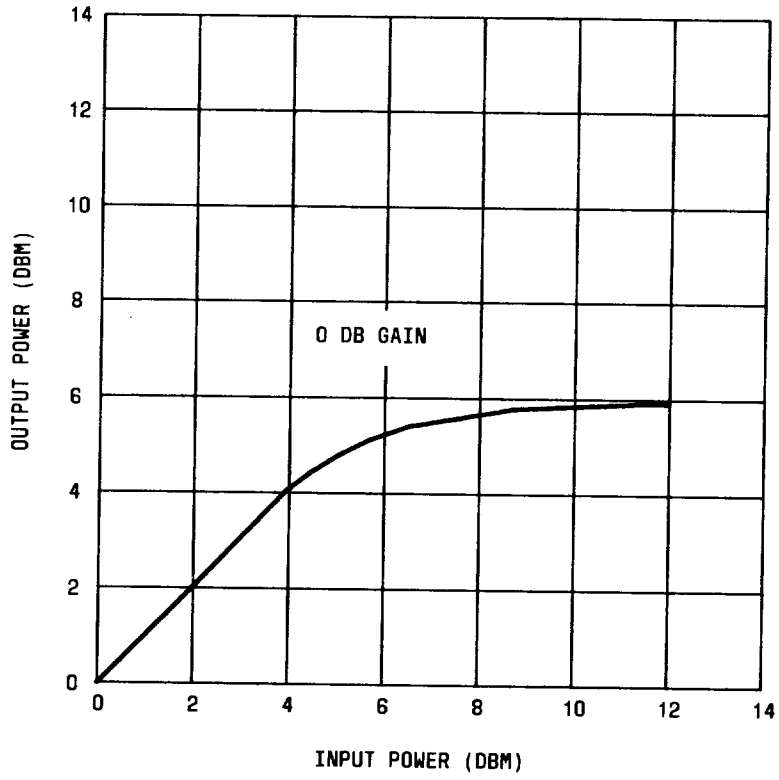


Fig. 5—Output Power Characteristics Curve