MODEL 213400 MULTI-CHANNEL DIGITAL ANNOUNCER

EQUIPMENT DESCRIPTION

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1. GENERAL

1.01 The Cook Electric Model 213400 Multi-Channel Digital Announcer provides four channels of recorded voice messages. The unit's voice storage and reproduction capability utilizes digital encoding and decoding techniques, thus eliminating the use of magnetic storage media, such as tape or drum. The digital announcer is a microprocessor-based unit, and can be configured to provide up to a maximum of 184 seconds for recording of voice messages. The announcer permits local recording of four variable length messages on four separate channels. Total length of the four messages can be no greater than the total length of message memory provided in the equipment. Various options and accessories are also offered to expand the capabilities of the multi-channel digital announcer.

1.02 This section provides the equipment description, specifications, and general operating principles of the Model 213400, plus an explanation of the various options and accessories available.

1.03 References.

756-0224-200 Model 213400 Multi-Channel Digital Announcer, Installation.

756-0224-300 Model 213400 Multi-Channel Digital Announcer, Operating Procedures.

756-0224-400 Model 213400 Multi-Channel Digital Announcer, Maintenance.

For additional information, contact:

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2. DESCRIPTION

PURPOSE OF EQUIPMENT

2.01 The Cook Electric Model 213400 Multi-Channel Digital Announcer (see figure 1) provides four channels of recorded voice messages, utilizing the latest in digital recording techniques. For each channel, the voice message is recorded electronically, stored as digital signals in solid state memory chips, reconstructed and played back on command. The announcer is capable of high quality voice recording and reproduction, which will not degrade with use. Thus, the use of digital recording completely eliminates the use of magnetic tape or drums and the associated electrical and mechanical operating devices.

MESSAGES

2.02 The Model 213400 Multi-Channel Digital Announcer can be obtained with voice message storage up to a maximum of 184 seconds. Variable length messages can be recorded on any of the four channels up to the point where the total length of the four messages will equal the total amount of message storage time available. Thus, a message may be short or long, as necessary. The total length of the four recorded messages may be less than the message storage available, but may not exceed it. If exceeded, a portion of the last message will be cut off. Control signals are provided at the beginning and end of each message interval for control of party

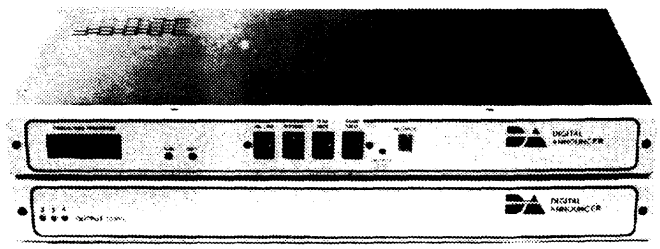

Fig. 1 – Model 213400 Multi-Channel Digital Announcer

cut-through and disconnect on external intercept trunks. Output of voice announcements and control signals for each channel are provided at interface connectors on the rear panels of the announcer.

CONFIGURATION

2.03 The Model 213400 Multi-Channel Digital Announcer consists of two aluminum chassis: (1) the Control Processor (C.P.) Chassis, and (2) the Multi-Channel (M.C.) Chassis. When installed, the C.P. Chassis will be located directly above the M.C. Chassis. The two chassis will be connected by a ribbon cable assembly through rear panel connectors.

2.04 Each chassis is 17.5 inches (445 mm) wide, 12 inches (305 mm) deep, and 1.75 inches (44 mm) high. (When rack-mounted, the two chassis use two rack spaces in the standard relay rack.)

2.05 The Multi-Channel Digital Announcer can be ordered with brackets for mounting to 19-inch (483 mm), 23-inch (584 mm), 26-inch (660 mm), or 28-inch (711 mm) relay racks. Alternate mounting holes are furnished on the sides of the chassis for installing mounting brackets, permitting adjustment of the distance the announcer cases extend out from the front and rear of the rack. The announcer can also be obtained without mounting brackets for table top use, in which case the C.P. Chassis is stacked on top of the M.C. Chassis.

2.06 C.P. Chassis. The C.P. Chassis contains the microprocessor and message memory store, is used to control the announcer, and provides the Channel No. 1 output circuitry. The front panel of the C.P. Chassis provides the main operating controls and indicators for the announcer.

2.07 The multipurpose four digit display shows the following information:

(a) Channel number and time remaining during recording.

(b) Channel number and actual recorded message length during playback.

(c) Channel number and peg count (when requested).

(d) Alarm messages associated with the announcer's built-in self-diagnostic program.

(e) Displays channel number(s) accessed when unit is in use (in On Line mode).

2.08 Also located on the front panel are four momentary pushbuttons for function control, four LED status indicators, a modular jack for recording or monitoring, and an output level control for adjusting the output volume of Channel No. 1.

2.09 On the rear panel of the C.P. Chassis, the "J2" opening offers access to the circuit board for the installation of the 20-pin wire-wrap edge connector which provides the power connection to the chassis and the signal Input/Output interface for Channel No. 1. Also provided are a toggle switch for controlling power to the chassis, a DIP switch (S6) for option selection, and a connector for the ribbon cable connection between the two chassis. (Models with Battery Backup option also provide a toggle switch for controlling backup battery power.)

2.10 M.C. Chassis. The M.C. Chassis contains the output circuitry for Channels No. 2, No. 3, and No. 4, and provides three output level controls on the front panel for adjusting output volume of Channels No. 2, No. 3, and No. 4.

2.11 On the rear panel of the M.C. Chassis, the "J2M" opening offers access to the circuit board for installation of the 44-pin wire-wrap edge connector which provides the power connection to the chassis and the signal Input/Output interfaces for Channels No. 2, No. 3, and No. 4. Also provided are a toggle switch for controlling power to the chassis, two DIP switches (S2 and S3) for option selection, and a connector for the ribbon cable connection between the two chassis.

3. SPECIFICATIONS

3.01 Operating specifications for Model 213400 Multi-Channel Digital Announcer are given in table 1.

3.02 Selectable options, factory-installed options, and accessories for Model 213400 Multi-Channel Digital Announcer are listed in table 2; however, the operation and use of some of these items are explained in other sections of this manual.

3.03 Part number ordering information for Model 213400 Multi-Channel Digital Announcer is given in table 3.

4. OPERATING PRINCIPLES

4.01 The Model 213400 Multi-Channel Digital Announcer provides four channels of digitally recorded voice announcements, and consists of two chassis: the Control Processor (C.P.) Chassis and the Multi-Channel (M.C.)

Table 1. Operating Specifications

CHARACTERISTIC	DESCRIPTION
Operational	
Message Length	Basic message capacity is 32 seconds total for the unit, which if divided equally between channels, is 8 seconds per channel. Extra memory can be added to the total message capacity in increments of 16 seconds. In actual practice, message lengths can be different on each channel, up to the point where the total of all four channels does not exceed the maximum message capacity of the announcer.
Peg Count (per channel)	Provides peg count up to 999,999 per channel, overflowing to zero.
Sampling Frequency	32 kHz/24 kHz, selectable by C.P. Chassis DIP switch S6. (Total message capacity with basic 16 chip circuit board: at 32 kHz, 32 seconds; at 24 kHz, 42 seconds.) (See Section 756-0224-300 for selection procedure.)
Message and Control Connections (Wire-wrap Terminals at Channel Interfaces)	
Tip and Ring (per channel)	4-ohm, transformer isolated, MOV protected.
ST+, ST- (per channel)	Start Pulse Input, -BATT or GND start, 16 mA (approx.); level sensitive. ("Level" start or "pulse" start selectible by DIP switch.)
MBY (per channel)	Make Busy Output. Form C Relay contacts. 4A maximum load, 30 Vdc resistive.
C/MC (per channel)	Beginning of Message/Ending of Message Sync Pulse Output, Form C Relay contacts. 250 millisecond duration ±10 milliseconds. 4A maximum load, 30 Vdc resistive.
ALM (C.P. Chassis only)	Alarm Output. Form C Relay contacts. 4A maximum load, 30 Vdc resistive.
-48 Vdc/GND (each chassis)	-48 Vdc Battery and Battery Ground Input Terminals. (The -48 Vdc line to be jumpered to the two chassis, and fused externally at 4A.)
Electrical	
Input Power	-42 Vdc to -56 Vdc at 1A maximum; each chassis internally fused at 1A, MOV protected. (115 Vac with optional AC Adapters.)
Tip/Ring Output Loading (per channel)	Each channel capable of driving up to two hundred 900-ohm trunks, or up to one hundred-fifty 600-ohm trunks.

Table 1. Operating Specifications (contd)

CHARACTERISTIC	DESCRIPTION
Performance	
Voice Input	Standard telephone headset, handset, or input from cassette recorder, using a modular plug to fit standard modular jack on announcer. (Transmitter 1000 ohms resistance or less, approx. -10 dBm; e.g., Northern Telecom Inc. Type G Handset.) Remote Record option permits voice input from remote pushbutton telephone.
Frequency Response	300 Hz to 3 kHz (300 Hz to 2.7 kHz, ±1 dBm).
Signal to Noise Ratio	Greater than 45 dBm, C message weighted.
Distortion	Less than 6% THD (Total Harmonic Distortion) at 0 dBm output, 1 kHz sine wave, -10 dBm input.
Output Impedance (per channel)	4 ohms, transformer isolated.
Environmental	
Temperature	Storage: -20° to +70° C. Operating: 0° C to 50° C.
Humidity	Maximum 90 percent relative humidity (non-condensing).
Physical	
Height	Each chassis: 1.75 inches (44.5 mm); one standard rack space. Total: 3.5 inches (89 mm); two standard rack spaces.
Width	17.5 inches (445 mm). Available with brackets for mounting on 19-inch (483 mm), 23-inch (584 mm), 26-inch (660 mm), or 28-inch (711 mm) relay rack.
Depth	12 inches (305 mm). Alternate mounting holes on cases permit adjustment of extension in front of and behind mounting surface.
Weight	10 Pounds (approx.): both chassis.

Table 2. Selectable Options, Factory-Installed Options, and Accessories

TYPE	DESCRIPTION
Selectable Options (DIP Switch Operation)	
SIT (Special Information Tone) Selection	SIT code signals, sent at the beginning of message transmission, are used in some telephone systems to signal equipment for various reporting operations, as determined by the local system. Selection of SIT code generation for each channel is possible with DIP switches on the chassis rear panels. See Section 756-0224-300 for selection procedures. SIT code generation is only available at the 32 kHz sampling frequency.
Sampling Frequency Selection	Sampling frequency rates of 32 kHz or 24 kHz are selectable with DIP switch S6 on the C.P. Chassis rear panel. See Section 756-0224-300 for selection procedure.
Start Command Selection	"Level" or "pulsed" start commands are selectable with DIP switch S6 on the C.P. Chassis rear panel. ("Pulsed start" makes the digital announcer compatible with Northern Telecom SL-1 Switch.) See Section 756-0224-300.
Factory Installed Options	
Battery Back-up of Message	With this factory-installed option, the announcer is protected against message loss due to loss of power. Four re-chargeable batteries are included in special circuitry, which will retain the message in memory, even if external power to the unit is lost. Otherwise, a loss of power will cause a loss of messages, requiring re-recording all four channels after power is restored. See table 3 in this section for ordering the announcer with this option. See Section 756-0224-400 for battery replacement procedures.
Remote Record Option	With this factory-installed option, messages can be recorded and monitored from a pushbutton telephone at a remote location. See table 3 in this section for ordering the announcer with this option.
Accessories	
Mounting Bracket Kits	The digital announcer may be obtained with mounting brackets furnished, as indicated in table 3 in this section, or mounting brackets may be obtained separately for changing mounting to another rack size. Since the multi-channel digital announcer consists of two separate chassis, two mounting bracket kits are required for each installation. Mounting bracket kits are available as follows: 19-inch (483 mm) rack -- Cat. No. 213281-101 23-inch (584 mm) rack -- Cat. No. 213281-103 26-inch (660 mm) rack -- Cat. No. 213281-105 28-inch (711 mm) rack -- Cat. No. 213281-113

Table 2. Selectable Options, Factory-Installed Options, and Accessories (contd)

TYPE	DESCRIPTION
Cassette Adapter Plug Assembly	This accessory adapts the output of a portable cassette recorder to fit the modular audio input jack on the digital announcer, permitting recording of voice announcements from cassette tape. Order Cat. No. 213284.
Handset	Accessory handset has a cord terminated with a modular plug to fit the modular (RJ11) input jack on the digital announcer, for recording and monitoring. Order Cat. No. 213285.
Handset Equipped With Mini-Cassette Jack	Accessory handset has cord terminated with a modular plug to fit the modular (RJ11) input jack on the digital announcer, for recording and monitoring. This handset is also equipped with a built-in mini-cassette jack for accepting the output of a portable cassette recorder permitting recording of voice announcements from cassette tape. The mouthpiece of the handset is disabled when a mini-plug is inserted into the handset mini-jack. Order Cat. No. 213360.
AC Adapters (Two Required)	This accessory is designed to operate both chassis of the multi-channel digital announcer from 115 Vac 60 Hz power, using one adapter unit for each chassis. Order two of Cat. No. 213288.

Chassis. The C.P. Chassis provides the main controls and indicators for operating the announcer. Contained on this chassis is the modular (RJ11 type) jack used for recording and monitoring the voice announcements, the microprocessor used to control system operation, memory circuits used for storage of all four recorded channels, and the output circuitry and signal interface for Channel No. 1. The M.C. Chassis provides the output circuitry and signal interfaces for Channels No. 2, No. 3, and No. 4. The two chassis are connected together on the rear panels by a ribbon cable assembly.

4.02 Digital recording techniques are employed for recording and reproducing the four channels of voice announcements. With the channel numbers selected in sequence (starting with Channel No. 1), messages are recorded by speaking into a handset or headset, or by playing a pre-recorded message on a cassette tape unit, connected to the input jack on the C.P. Chassis. (The record interlock, which prevents entry into record mode unless one of these devices is connected to the input jack before pressing the RECORD pushbutton, also prevents a message from being accidentally erased.) Voice is converted to an audio signal at the input circuits of the announcer. Then, under microprocessor control, these analog signals are sampled many times a second and broken into a series of individual voltages. These voltages are converted into digital signals, which are stored in memory chips on the circuit board in the C.P. Chassis.

4.03 The messages are stored in memory in channel number sequence; however, the total block of memory does not have to be divided equally among the four channels. To permit storing messages of varied lengths and still promote the economical use of memory capacity, where one message ends, the next message begins. The start and end of each channel message is marked in the memory by address pointers. The start address pointer for Channel No. 1 is always the same, but the stop and start address pointers for the subsequent channels are always variable. When the recordings are made, the microprocessor remembers the start and stop address pointers for each channel. Then, when the announcer is on line and being accessed, the microprocessor recognizes which channel is required and goes to that address pointer to retrieve the message data.

4.04 Since messages are stored in memory in channel number sequence, the four channels must be recorded in that sequence, starting with Channel No. 1. Each channel will use only the amount of memory required for the length of its message.

Table 3. Multi-Channel Digital Announcer Model Number Ordering Information

Determine Desired Catalog Number According to the Following Directions:

XXXXXX - XX XXX X X

A.	Digital Announcer Type	Enter No.
	Multi-Channel	213400
B.	Brackets for Relay Rack Mounting	Enter No.
	None	00
	For 19 -inch (483 mm) Rack	19
	For 23-inch (542 mm) Rack	23
	For 26-inch (660 mm) Rack	26
	For 28-inch (711 mm) Rack	28
C.	Total Recording Time*	Enter No.
	32 Seconds	032
	48 Seconds	048
	64 Seconds	064
	80 Seconds	080
	96 Seconds	096
	112 Seconds	112
	128 Seconds	128
D.	Battery Backup of Message Option	Enter No.
	No	0
	Yes	1
E.	Remote Record Option	Enter No.
	No	0
	Yes	1

EXAMPLE: 213400 - 19 080 1 0

A. Multi-Channel Digital Announcer

B. Bracket for 19-inch Relay Rack Mounting

C. 80 Seconds Total Recording Time

D. With Battery Backup of Message Option

E. Without Remote Record Option

*At 32 kHz sampling rate.

4.05 When starting to record Channel No. 1, the digital display on the C.P. Chassis front panel will indicate the total recording time (in seconds) provided for all four channels and will count down the seconds until the Channel No. 1 recording process has been stopped. Then, Channel No. 2 is selected automatically, and the digital display will indicate the available time remaining for recording the remaining three channels. When recording the Channel No. 2 message, the digital display resumes seconds countdown from where it left off, until the Channel No. 2 recording has been stopped, and Channel No. 3 selected automatically. Channels No. 3 and No. 4 are recorded in the same manner, with the digital display showing available time remaining and counting down during recording. Therefore, it is apparent that message

length can vary for each channel; however, the total length of the four recorded messages cannot exceed the total recording time provided by the digital announcer.

4.07 When the messages are played back and monitored, the digital display will now indicate the actual length (in seconds) of the recording in each channel, and will count down to zero as each message is played back.

4.08 When the digital announcer is placed "on line", the receipt of an external start command signal at a channel interface will cause the microprocessor to initiate a program to retrieve the stored digital signals for that channel. The retrieved digital data is converted back to analog, and outputted at that channel's interface as voice, duplicating the original message. More than one channel may be accessed at a time. The channel(s) accessed will be indicated by the number on the digital display .

4.09 Power for the multi-channel digital announcer is supplied from the office battery (-48 Vdc). Power input is made through the rear panel interfaces of the two chassis; J2 on the C.P. Chassis, J2M on the M.C. Chassis. Both chassis are fused internally at 1A by replaceable 3AG slow-blow fuses, and power is switchable on both chassis by POWER switches on the rear panels. In both chassis, power supplies are reverse voltage protected, and the DC-DC converters, which provide the necessary +5V and +12V, are short circuit protected.

4.10 The operation of the multi-channel digital announcer is controlled by a microprocessor, located in the C.P. Chassis. The microprocessor controls such functions as Record and Playback, as well as various housekeeping functions, peg count, external status indicators, and a built-in diagnostic program used to assist the user in locating faults and illegal commands. Also located in the C.P. Chassis is the Dynamic Random Access Memory (DRAM), used to store the digital message data for all four channels.

4.11 Both the encoding (Analog-to-Digital or A/D) and decoding (Digital-to-Analog or D/A) of the voice I/O signal is accomplished by a Continuously Variable Slope Delta Modulator (CVSD) integrated circuit, via a serial bit stream. In RECORD mode, the CVSD in the C.P. Chassis is set up to encode, and in PLAYBACK mode, to decode, for all four channel messages. When in ON LINE mode, the CVSD in the C.P. Chassis is set up to decode for Channel No. 1, and the three CVSD's in the M.C. Chassis are set up to decode for Channels No. 2, No. 3, and No. 4.

4.12 A simplified block diagram of the multi-channel digital announcer operation in RECORD mode is shown in figure 2, and explained as follows. The CVSD in the C.P. Chassis is set up to encode (A/D). The analog voice signal for the channel being recorded is clocked into the CVSD by the sampling frequency. The digital output of the CVSD is a serial bit pattern representing the analog input. The serial pattern is converted to parallel form in the shift register, and the microprocessor stores this data in Dynamic RAM. Data is entered and stored in Dynamic RAM in channel number sequence: Channels No. 1 through No. 4. The beginning and end of each channel is identified in the memory by address pointers.

4.13 A simplified block diagram of the multi-channel digital announcer operation in PLAYBACK mode is shown in figure 3, and explained as follows. The CVSD in the C.P. Chassis is set up to decode (D/A). With the desired channel number selected, digital data previously recorded and stored for that channel is now retrieved from Dynamic RAM in parallel form by the microprocessor, serialized in the shift register, and fed into the CVSD. The original analog signal is reconstructed by the CVSD. The analog signal is then filtered to remove the clock frequency component, amplified, and sent out to the Tip and Ring pins at the J2 interface. This output circuit is paralled by monitor jack J1, permitting the output to be monitored by a handset or headset connected to the jack. (In PLAYBACK mode, all channels are outputted to the J2 interface for monitoring.) During playback, the digital display will show the actual message length in seconds and will countdown to zero as the message is being played.

4.14 A simplified block diagram of the multi-channel digital announcer operation in ON LINE mode is shown in figure 4, and explained as follows. When "on line", the digital announcer is ready to accept external start commands at the various channel interfaces. In ON LINE mode, the C.P. Chassis provides the circuitry and interface (J2) for Channel No. 1 output; the M.C. Chassis provides the circuitry and interfaces (J2M) for output of Channels No. 2, No. 3, and No. 4. Each channel can be independently accessed with a separate start command at its respective interface. (Accessed channel numbers will be shown on the digital display.) When a start command is received at one of the interfaces, the microprocessor recognizes the channel accessed retrieves the data for that channel from memory, and routes it to the proper channel by a scanning process, where the original voice signal for that channel is regenerated by the corresponding CVSD and output circuitry.

4.15 The output level for all four channels is user adjustable. The OUTPUT LEVEL control for Channel No. 1 is located on the C.P. Chassis front panel. The OUTPUT LEVEL controls for Channels No. 2, No. 3, and No. 4 are located on the M.C. Chassis front panel.

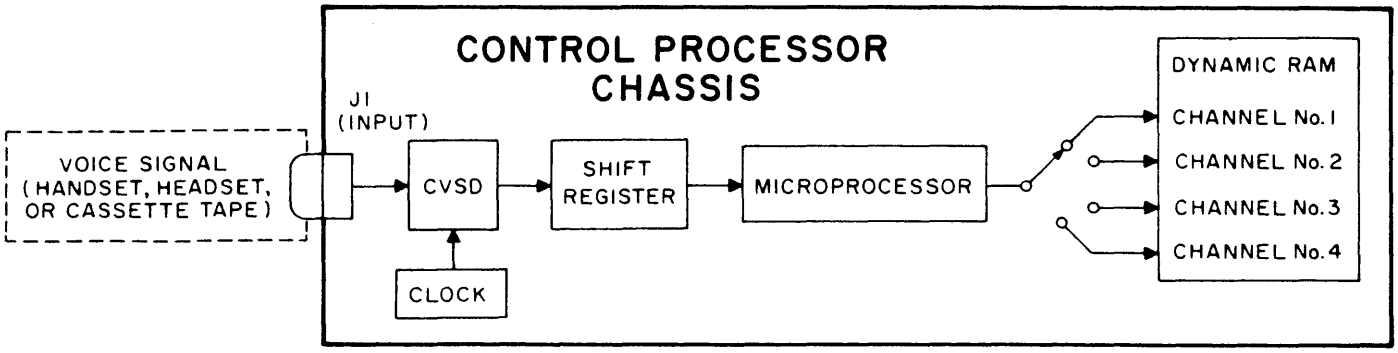

Fig. 2 – RECORD Mode Block Diagram

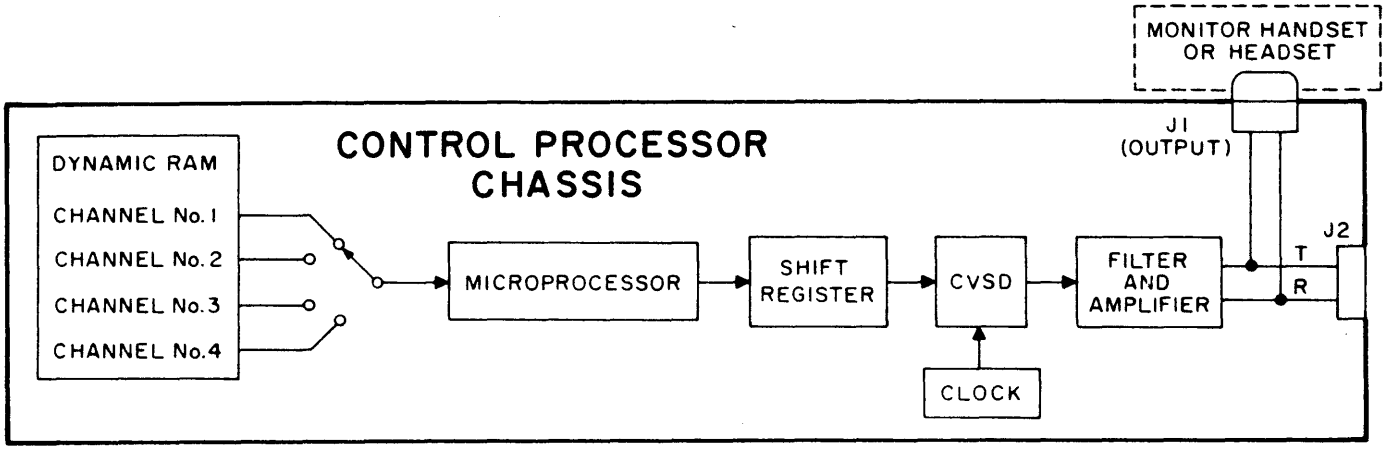

Fig. 3 – PLAYBACK Mode Block Diagram

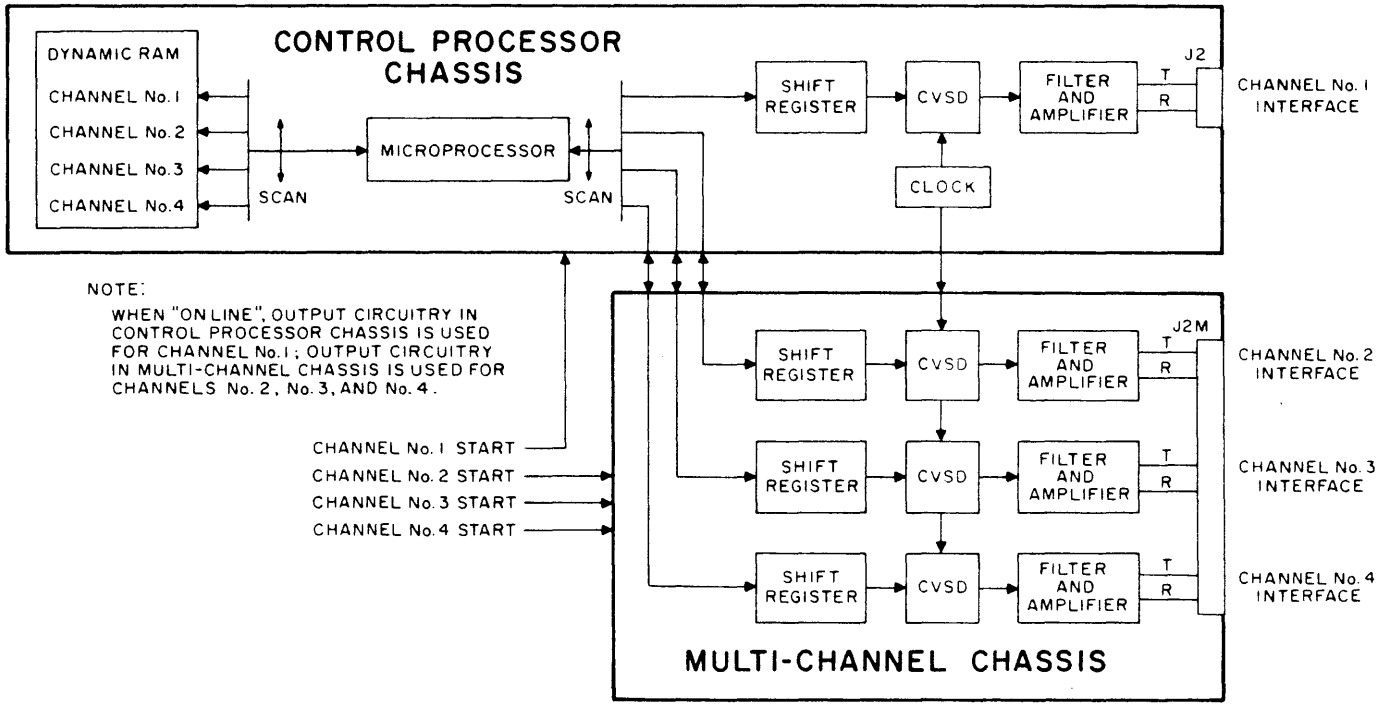

Fig. 4 – ON LINE Mode Block Diagram

4.16 Visual indicators are provided on the C.P. Chassis front panel to aid the user in operating the digital announcer. These include the ON LINE, RECORD, ALM (Alarm), and RMT (Remote) LED's (Light Emitting Diodes). At the left on the panel is the STATUS/TIME REMAINING digital display. The use of these displays and the operation of the announcer are explained in Section 756-0224-300, Operating Procedures, in this manual.

4.17 Start Commands. When the digital announcer contains recorded messages and is put ON LINE, the unit is ready to accept start commands at the channel interfaces. The start command can be either a GROUND start or a -BATTERY start, as shown in figure 5.

4.18 A "level" start or a "pulse" start mode can be selected by DIP switch S6-7, located on the rear panel of the C.P. Chassis (see selection procedure, Section 756-0224-300).

4.19 There are several start modes that effect the operation of the announcer. Changing the program firmware modifies the microprocessor's instruction set, which in turn controls how it will respond to different start signals. The start options are described in detail in the firmware pubications (60-213405-XXX).

4.20 Visual indicators are provided on the digital announcer's front panel to aid the user in operating the unit. These include the ON LINE, RECORD, ALM (Alarm), and RMT (Remote) LED's. At the left is the STATUS/TIME REMAINING digital display. The use of these displays and the operation of the unit are explained in Section 756-0224-300, Operating Procedures, in this manual.

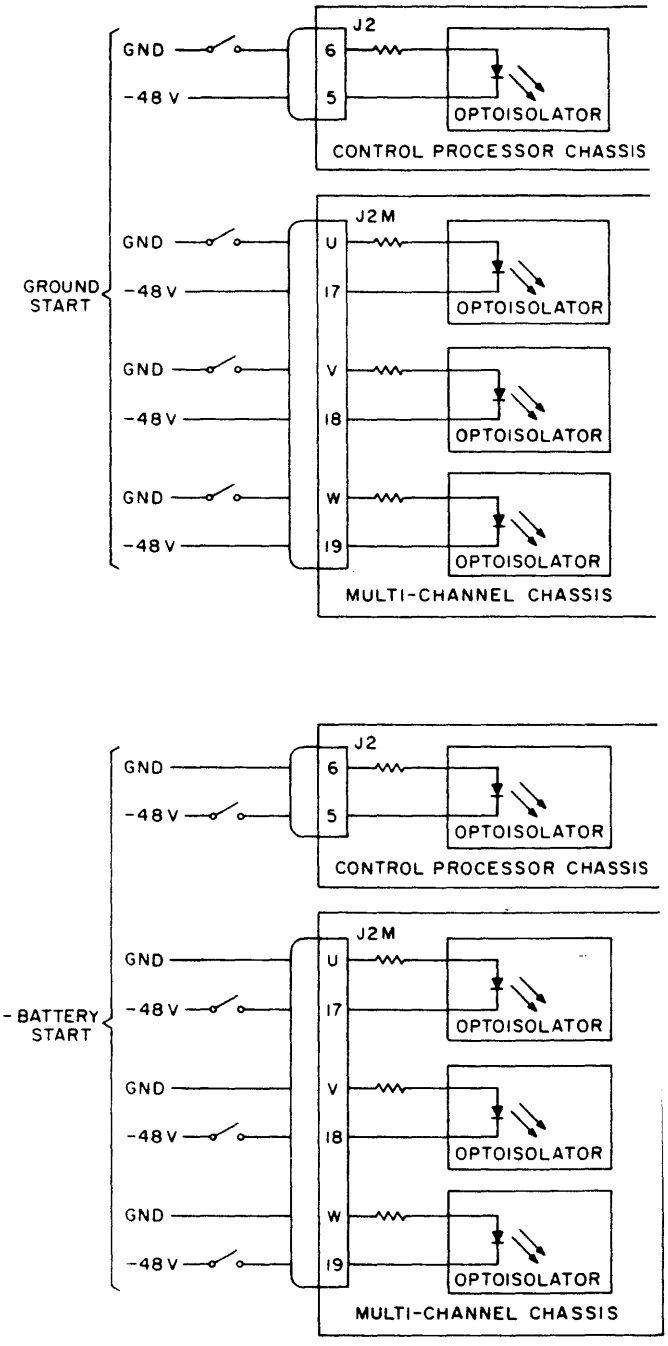

Fig. 5 - Start Mode Wiring Diagrams

5. FCC REGULATIONS

GENERAL

5.01 The Digital Announcer series of equipment manufactured by Northern Telecom Inc., Cook Electric Division, has several versions for various announcement applications. These Digital Announcers comply with FCC Rules Part 68 as an adjunct used with PBX's and have been given FCC Registration Number:

D5F982-13986-PX-N

OUTPUT LEVEL

5.02 These various announcers are designed to connect to an appropriate PBX Announcer trunk interface circuit, or to be used with the Cook Electric Ring Trip Access Circuit, or any protective coupler, when connecting to a standard telephone line.

5.03 Output signal power level has been factory set at -9 dBm in accordance with FCC Regulations Part 68.

5.04 For Central Office applications only, the output level may be adjusted by breaking the seal over the LEVEL ADJUST.

NOTE: MAKING THIS ADJUSTMENT WILL VOID THE FCC REGISTRATION.

This seal, and LEVEL ADJUST, are located on the front panel of each of the individual chassis.

5.05 Table 4 is provided to identify those equipments which fall under the requirements of the applicable FCC requirement.

RADIO FREQUENCY RADIATION

5.06 The following warning applies to all versions of the Digital Announcers listed in table 4.

Table 4. Affected Equipments

DESCRIPTION	PART NO.
Single Channel Digital Announcer	213300
Deleted	------
Multi-Channel Digital Announcer	213400
Four Channel Synchronous Digital Announcer	213420
Four Channel Demand Phased Entry Digital Announcer	213500
Four Channel Time Phased Entry Digital Announcer	213550

WARNING:

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Table 4. List of Abbreaviations used in text

ABBREVIATION	DEFINITION
A	Ampere
A/D	Analog-to-Digital
ALM	Alarm
B.O.M.	Beginning of Message
C	Centigrade
C/MC	Beginning of Message/Ending of Message Sync Pulse
C.P.	Control Processor
CVSD	Continuously Variable Slope Delta (Modulator)
D/A	Digital-to-Analog
dBm	Decibels referenced to one milliwatt
Dc	Direct Current
DIP	Dual In-line Pin
DRAM	Dynamic Random Access Memory
E.O.M.	End of Message
GND	Ground
HS	Headset
Hz	Hertz
IC	Integrated Circuit
IO	Input/Output
kHz	Kilohertz
LED	Light Emitting Diode
mA	Milliamperes
M.C.	Multi-Channel
MBY	Make Busy
MIC	Microphone
MON	Monitor
MOV	Metal Oxide Varistor
R	Ring
REC	Record
SEL	Select
SIT	Special Information Tone
ST	Start
T	Tip
THD	Total Harmonic Distortion
Vac	Volts alternating current
Vdc	Volts direct current