5ESS® SWITCHING EQUIPMENT
DIGITAL SERVICE UNIT
MODEL 2
CIRCUIT

Description of Changes

The apparatus changes include the availability of the Service Announcement System, hereafter known as SAS, which is designed to provide a high capacity announcement system that provides both recorded announcement function (RAF) transparency and an improved platform on which to accommodate new capabilities such as Speech Recognition and Speech Recording and Playback. The initial application of SAS is in the DSU2.

A SAS "physical service group" consists of two major components, a controller circuit pack, the TN1841 SAS Digital Service Circuit (SASDSC), and up to four TN1842 SAS Memory Circuits (SASMEM). These two circuit packs are plug compatible with the existing DSU2 and can be placed in any slot position of the DSU2 except position 0 (EQL 008). A SAS physical service group is created by placing a controller board, TN1841, in any slot position (except position 0) with at least one but not more than four TN1842 memory boards in the slots immediately to the right of the controller board. The maximum number of physical service groups that can be equipped in a DSU2 is eight. The spanning of SAS physical service groups across the fuse groups of the DSU2 is feasible, but it must be realized that the loss of even one SASMEM due to a fuse failure will cause the entire SAS physical service group "out-of-service", even though most of the service group is in a service group whose fuse has not failed. The maximum number of physical service groups that can be equipped in an MCTU2 SM is eight.

The TN1841 SAS Digital Service Circuit (SASDSC) contains the digital signal processors and provides the PICB and PIDB interface to the SM and the interface to the SAS memory.

The TN1842 SAS Memory Circuit (SASMEM) can be equipped from one to four per SAS physical service group. Each memory circuit, in turn, can be equipped with from one to eight (feature dependent) PCMCIA Flash Memory Cards. The memory cards would be preprogrammed per customer specifications for desired functions. The initial application for SAS with generic 5EE7(1) will use a flash memory card with a 4MB capacity, which equates to 422 seconds of recorded speech. As larger capacity memory cards are qualified, they will be added to the availability list.

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5ESS® SWITCHING EQUIPMENT
DIGITAL SERVICE UNIT
MODEL 2
CIRCUIT

Description of Changes

The apparatus changes include the upgrading of the TN833 Digital Service Circuit Pack to support Automatic Power Restart, and three new microcoded circuit packs. Two are upgrades of an existing microcode, MC5D172A, while the third is new, MC5D198A.

The TN833 Digital Service Circuit has been modified to provide Automatic Power Restart for protection of the circuitry in the DSU2. This modification requires a new printed wiring board and additional components that add a turn on/turn off circuit which keeps the output of the on-board power converter, PS1, off until its supply voltage reaches -38.4Vdc. The power converter has a turn-on point between -26 and -28Vdc, at this input, the +5Vdc output could be at a level that might cause damage to the on-board circuitry and that of any of the circuit packs that the TN833 can control (TN1053 and TN1054). The APR circuitry prevents this possible damage by monitoring the -48Vdc battery, and using -38.4Vdc as a turn-on/ turn-off point for the PS1 power converter. This modification results in the new TN833 circuit being suffix coded as a TN833C for recognition purposes. This suffix code is also applied to the three associated orderable microcodes, MC5D073A1C, MC5D085A1C, and MC5X276A1C. The existing TN833 and associated microcodes will be discontinued. The APR circuit is optional for those installations desiring it, and is implemented with the installation of 963E-2 jumper across backplane pins 221 and 222 of the location occupied by the TN833C.

MC5D172 (TN1054), operator services position system [OSPS] voice messaging service (VMS), has been upgraded to version A2 for use with generic 5E8.

MC5D172 (TN1054) has been upgraded to version A3 to provide operator services position system [OSPS] voice messaging service (VMS) and for generic 5E9.

MC5D198A (TN1053) has been added as version A1 to provide 250 call-seconds of announcements that can be customized. This circuit pack is for use with generic 5E9 and later.

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5ESS® SWITCHING EQUIPMENT
DIGITAL SERVICE UNIT
MODEL 2
CIRCUIT

Description of Changes

The apparatus change is a new set of announcement phrases which has been developed for the TN1054 expansion announcement storage circuit (EASC) microcode carrier pack. It will be identified as MC5D172A1.

MC5D172 (TN1054) has been added to provide operator services position system (OSPS) voice messaging service (VMS) for generic 5E7 and it will be identified as version A1.

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5ESS® SWITCHING EQUIPMENT
DIGITAL SERVICE UNIT,
MODEL 2
CIRCUIT

Description of Changes

Apparatus changes include the following.

- Four recorded announcement circuit packs have been upgraded to include additional feature.
- Three are based on the TN1053 announcement storage circuit (ASC) microcode carrier pack: MC5D087A2, MC5D114A4, and MC5D142A2, and one on the TN1054 expansion announcement storage circuit (EASC) microcode carrier pack, MC5D143A3.

MC5D087 (TN1053), operator services position system (OSPS) directory assistance announcements, has been upgraded to version A2.

MC5D114 (TN1053), customer account services (CAS-R3) announcements, has been upgraded to version A4.

MC5D142 (TN1053), customer originated trace (COT) & auto callback (AC) announcements, has been upgraded to version A2.

MC5D143 (TN1054), automatic customer station rearrangement (ACSR), local area signaling services (LASS), and screen list editing (SLE), has been upgraded to version A3.

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5ESS® SWITCHING EQUIPMENT
DIGITAL SERVICE UNIT, MODEL 2 CIRCUIT

CONTENTS

1. GENERAL DESCRIPTION

1.1 PURPOSE OF CIRCUIT

The digital service unit, model 2 (DSU2) houses a number of service groups which provide switching services such as tone generation/tone decoding which are classified as the local digital service unit function (LDSUF). Voiceband services such as centralized automatic message accounting (CAMA), individual calling line identification (ICLID), caller name identification (CNAM), voice path assurance (VPA), and the analog visual message waiting indicator (AVMWI) are included in the LDSUF. Services such as the integrated services test function (ISTF), transmission test function - version 2 (TTF2), and recorded announcement function (RAF), are also DSU2 functions.

1.2 GENERAL DESCRIPTION OF OPERATION

The TN833 digital service circuit (DSC) is required for all functions that the DSU2 performs. The TN833 is a microcode controlled carrier pack that supports three distinct microcodes, the MC5D073A1, the MC5D085A1, and the MC5X276A1. The microcode MC5D073A1 provides local digital service unit functions using erasable programmable read only memory (EPROM) based firmware. Beginning with the 5E3 generic, the microcode MC5D085A1 is classified as "pumpable", in that it has the ability to be downloaded with software to program the DSU2 for specific features. All programmable DSU2 functions are programmed through an initialization data block (IDB) and resident software (RSW) to perform the desired task. The MC5X276A1 microcode provides for special audible ringing and a busy signal, and is primarily intended for 5E2(2) British Telecom applications.

The TN833 (DSC) that supports LDSUF provides the basic digital services needed on a per switching module (SM) basis. The services are needed for regular call-processing or special call needs. The digital signal processors (DSPs) on the DSC are allocated to provide the appropriate services, which can include any of the following:

— Call progress, TOUCH-TONE™, and multi-frequency (MF) tone generation and outpulsing

— TOUCH-TONE™, multi-frequency and dial-pulse digit detection

— Multi-frequency compelled signaling for international needs

— Voice path assurance (VPA) testing

— Voiceband data generation (VBDG) services, including ICLID, CNAM, and AVMWI signaling

— CAMA tone detection

— Generation of inband and multiwink signals for Operator Services Position System (OSPS)

Each of the various services are provided by a variety of DSP types which are defined on a per DSC basis. This capability requires no expansion boards.

The ISTF is supported by a TN833 DSC that acts as a digital testing device that measures bit error rates and error blocks on channels of a peripheral interface data bus (PIDB) that is connected to the ISTF through a TSIU. The ISTF requires no expansion boards.

The transmission test function, version 2 (TTF2) is also supported by a TN833 DSC that allows the customer to run trunk test calls using the DSU2. TTF2 provides the customer with the ability to generate tests that measure signals, provide custom tone generation, and call progress tone detection in a variety of trunks. TTF2 requires no expansion boards.

The recorded announcement function (RAF) uses a TN833 DSC (independent of the TN833 DSC required to provide the LDSUF) to provide up to 32 channels of independently phased, variable length pre-recorded announcements which are digitally stored in EPROM on the TN1053/TN1634 ASC. Phrases stored in the ASC are concatenated and sent out on the PIDB for playback to the customer. If additional announcement time is required for a particular application, up to two TN1054/TN1635 expansion announcement storage circuits (EASC) can be used in conjunction with the ASC.

2. DETAILED DESCRIPTION

2.1 CIRCUITS

TN833 DSC: Circuit pack schematic for manufacture (CPSM)-TN833 contains a detailed description of the DSC circuit pack. The following circuits support the operation of the DSPs and the LP:

- *Serial data interfaces (SDIs)* - The SDIs represent the DSC interface to its external time division multiplexed (TDM) bus (LDSU bus for local DSU functions). Each DSP communicates with the SDI over a TDM bus called the unit access port (UAP). The SDI can switch any time slot on any other TDM bus. The switching fabric of each SDI is controlled by an internal control random access memory (RAM) which can be read or written by the LP. Control of each UAP and the external TDM bus is done on a per time slot basis. The RAM is protected by parity.
- *Parity write protect (PWP)* - The PWP circuit provides parity and write protection. These functions are controlled by a register in the PWP circuit which is readable and writable by the LP. Parity is stored and checked over all RAM memory.
- *Unified control interface (UCI)* - The UCI furnishes the interface between the LP and the module processor (MP) through the peripheral interface control bus (PICB). Normal communication with the MP is on a first-in, first-out (FIFO) basis. Other functions, such as audits, diagnostics, and maintenance messages are expected to use a mailbox communication facility. Fundamental operations such as processor reset, loss of sanity, and loss of clock are handled directly by the MP.

TN1053 ASC: CPSM-TN1053 contains a detailed description of the ASC circuit pack. The ASC provides the interface to the announcement storage memory for the DSU2 RAF function through the expansion port interface (EPI), a custom integrated circuit that resides in its on-board circuitry. The ASC provides a maximum of 2 MBytes of announcement storage (262 seconds total time) in its EPROM. Announcement sets for the TN1053 are categorized by microcode number. The following tables lists the current available microcodes and their function:

MICROCODE	FUNCTION
MC5D087A1	OSPS DIRECTORY ASSISTANCE
MC5D114A3	OSPS TOLL & ASSIST, CAS-R3, MECH, SUB-ACCOUNT BILLING
MC5D142A2	RACF, COT, AUTO-CALLBACK
MC5D144A1	OSPS 800 DIRECTORY ASSISTANCE
MC5D151A1	ADVANCED SERVICES PLATFORM

The TN1053 also provides the gateway interface for up to two TN1054 EASCs when additional speech storage (time) is required.

TN1054 EASC: CPSM-TN1054 contains a detailed description of the EASC circuit pack. The EASC provides expansion announcement storage memory for the DSU2 RAF function of up to a maximum of 4 MBytes of EPROM (524 seconds total time). Announcement sets for the TN1054 are categorized by microcode number. The following table lists the current available microcodes and their function:

MICROCODE	FUNCTION
MC5D143A2	ACSR, LASS-SLE
MC5D155A1	CUSTOM ANNOUNCEMENT TEST

TN1634 ASC: CPSM-TN1634 contains a detailed description of the ASC circuit pack. The TN1634 is the apparatus coded version of the TN1053 and is intended primarily for the international market. The TN1634 is shipped from the manufacturing location with test microcode, MC5X279A1, installed. The test microcode is erased by the customer and reprogrammed with language specific announcements supplied by the customer using the recorded announcement workstation (RAW).

TN1635 EASC: CPSM-TN1635 contains a detailed description of the EASC circuit pack. The TN1635 is the apparatus coded version of the TN1054 and is intended primarily for the international market. The TN1635 is shipped from the manufacturing location with test microcode, MC5X280A1, installed. The test microcode is erased by the customer and reprogrammed with language specific announcements supplied by the customer using the RAW.

2.2 LOGICAL PROCESSOR (LP) FIRMWARE

The LP firmware handles the MP communications, digital service control, and routine tests and error reporting. This firmware consists of a base system plus a number of application programs.

2.3 DIGITAL SIGNAL PROCESSOR (DSP) FIRMWARE

The DSP firmware performs the algorithmic processing, which forms the core of most digital services. Programming of the DSPs is done in a highly specialized assembly language. The DSPs can then perform functions such as generating and decoding TOUCH-TONE™ signals.

2.4 INITIALIZATION DATA BLOCK

The initialization data block (IDB) is placed in the unified control interface (UCI) RAM by the switching module processor (SMP) at initialization time. The IDB tells the DSU2 what services to perform on each time slot, and which DSP to use for these services. The number of expansion packs is also in the IDB.

2.5 FUNCTIONS

Local Digital Service Unit Function (LDSUF): The LDSUF provides up to 30 bi-directional channels of local digital services. Two channels are reserved for testing purposes. Each DSC pack has seven DSPs which are allocated to provide the various local digital services.

Tone Generation: The tone generation function is used to provide call progress, TOUCH-TONE™ and multi-frequency tone generation, outpulsing on outgoing channels, and the generation of inband and multi-wink signals. These signals are for inter-office signaling, for coin control, and ring-back in OSPS. For international generics, the frequency, amplitude, and timing of the tones is stored in the office dependent database (ODD) to support various international requirements and is transferred to the DSC during initialization. Up to 30 channels of tone generation can be provided by one DSP.

Tone Decoding: The tone decoding function is used to provide TOUCH-TONE™, multi-frequency, and dial pulse detection on incoming channels. Up to five channels of tone decoding can be provided by a single DSP.

Tone Transceiver Function: The tone transceiver function is used to provide VPA testing and VBDG services. For international offices, the tone transceiver function also provides multi-frequency compelled (MFC) signaling.

VPA is used to test the voice channel when common channel signaling (CCS) is used. Both incoming and outgoing channels are used to support these tests, with up to five channels of the tone transceiver function being provided by a single DSP.

VBDG services which include, AVMWI, ICLID, and CNAM, all require the transmission of frequency shift keying (FSK) data using the voiceband digital interface - version 1 (VDI-1). AVMWI is activated on a called party's station to notify the party that messages are waiting. The DSU2 must transmit binary data to light or extinguish the lamp on the phone. The ICLID feature requires the transmission of the calling party's phone number to the called party during the quiet part of the ringing cycle. The CNAM feature requires the transmission of the caller's name and number to the called party. MFC signaling is used in international offices because it has a compelled protocol which requires the transmission and reception of tones to complete the signaling cycle.

CAMA Tone Decoding: The CAMA feature is used to provide detection of the tone signals required in CAMA access. The tone signal detected can indicate either automatic number identification failure (ANIF) or operator number identification (ONI). Up to 10 CAMA tone decoders can be provided by a single DSP.

Recorded Announcement Function (RAF): Generic 5E3 provides for the support of an additional circuit pack called the ASC. This circuit pack, TN1053, is classified as a microcode carrier pack that when programmed and used in conjunction with the TN833 DSC (MC5D085A1) permits the DSU2 to provide a new type of service group which performs playback of previously recorded announcements. The DSC used for a RAF service group is in addition to the DSC required for the LDSUF. From two to four service groups may be equipped with RAF. The RAF provides up to 32 independent, simultaneous, variable content announcement channels per service group. Up to 20 of the 32 channels may be configured as "interruptible" announcements by TOUCH-TONE™ or Multi-Frequency (MF) digits. Announcement services are activated upon receipt of requests from the SMP. The application software then sends an announcement request packet that contains:

- An announcement request opcode
- The PIDB time slot over which the playback should occur
- The number of phrase IDs associated with the request
- Up to 68 words identifying the phrases that the RAF should play

After validating the request, the RAF reads the ASC to obtain the speech samples associated with each phrase in the request packet. As these speech samples are read they are placed on the PIDB time slot associated with the request. An announcement complete report is sent to the SMP when all phrases specified in the request have been sent out.

ASC Configuration: The ASC can contain a maximum of 2 megabytes of EPROM memory for storage of digitized announcement speech samples. The amount of EPROM actually installed is application dependent and is reflected in the microcode assembly. Refer to section 2 on TN1053 for the available microcode numbers and their application. The ASC has as part of its circuitry the EPI chip, which provides a serial-to-parallel interface between the DSC and the ASC memory. The circuit also contains memory that holds party information over address and data for each 16 bits of data stored in announcement memory.

DSC to ASC Interface: The DSC interfaces time slots to the ASC over three dedicated TDM buses that are part of the serial data interface and are identified as expansion (EXP) ports. These buses carry the ASC address, control, and ASC read/write data.

Expansion Port Interface (EPI): The EPI of the ASC is a custom integrated circuit (IC) chip which

provides a serial-to-parallel conversion between the SDI EXP ports and the ASC announcement memory. The output from the EPI is a 24-bit address bus, an eight-bit bi-directional data bus, an eight-bit distribute/scan bus, and control signals.

Expansion Memory Interface (EMI): The ASC provides a parallel interface for up to two additional circuit packs (TN1054 - expansion announcement storage circuit introduced with generic 5E4) containing up to four megabytes of EPROM memory which can contain additional announcements for a particular application.

Logical Processor Usage: DSU2 service groups providing the recorded announcement application run LP software that schedules processing of announcement requests from the MP, sequences the DSP through the announcement playback, and issues completion and error reports in the MP.

Digital Signal Processor Usage: The DSP software performs the generation of announcement speech sample addresses to the ASC, retrieval of speech data from the ASC, and routing of the speech data to outgoing time slots to achieve playback. Phrase addresses are periodically sent to the DSP from the LP to sequence the DSP through playback.

Integrated Services Test Function (ISTF): The offering of generic 5E4 provides for the use of the DSU2 as an ISTF unit. ISTF requires the addition of a second DSC of the pumpable variety (MC5D085A1) over and above the one required to provide LDSUF. The ISTF acts as a digital testing device that measures bit error rates and error blocks on channels of a PIDB connected to the ISTF through a time slot interchange unit (TSIU). When the DSU2 acts as an ISTF it provides loopback service and transmission service. These services can be applied to any one of the first 31 channels on the PIDB. The thirty-second channel is reserved for internal routine maintenance. Recent change and verify is used to assign the services to an ISTF of they can be engineered in the ODD.

ISTF Loopback Service: A loopback service is provided when the bits received by the ISTF on a PIDB channel are sent back out of the ISTF on the same PIDB channel.

There are two types of loopback service, inverted and non-inverted. The inverted loopback service translates all the bits of an incoming channel (a value of 0 is transformed to a 1, and vice versa) before putting it back on the same outgoing channel. The non-inverting loopback service transfers the incoming data bits from the incoming channel to the same outgoing channel without any modification. A single DSP can simultaneously loopback any combination inverted/non-inverted) of 31 loopback channels.

ISTF Transmission Service: A transmission service provides the test for a digital bitstream. It involves sending a pattern from one DSP (one channel at a time) and receiving it on another DSP. The test reports how many bits were in error through the bit error rate, and whether the errors were clumped or not through the errored block count. Each channel being tested requires two DSPs, one for sending and one for receiving. The maximum number of channels simultaneously performing the transmission service test is three.

Mixed Services: Any combination of up to 31 loopback channels and three transmission services may be mixed and simultaneously tested with each ISTF unit (as long as the total number of services in use does not exceed the 31 channel limit of the PIDB). In other words you could have 30 loopbacks and one transmission, 29 and two, or 28 and three before the 31 channel limit is exceeded.

Transmission Test Function-Version 2: TTF2 is a test function that allows trunk test calls to be generated using the DSU2. Three functions are provided:

- Call disposition analysis (CDA)
- Tone generation (TGEN)
- Tone measure (TMSR)

These functions use three of the seven digital service circuit digital signal processor chips to perform the test operations. They can be applied to any of the 31 channels on the PIDB. The thirty-second channel is reserved for internal routine maintenance. Call disposition analysis uses a DSP to recognize call progress tone detection and voice detection. Predefined data is downloaded to the DSC to allow the CDA and TMSR functions to operate correctly. The DSP used for tone generation (TGEN) generates continuous and cadenced tones through outgoing channels. These tones can be custom defined by the office technician. The TMSR DSP is used in measuring continuous and cadenced tones. The CDA and TMSR DSPs are assigned to monitor the same PIDB channel/time slot.

3. REFERENCE DATA

3.1 WORKING LIMITS

Voltage

Static:	-41.75 Vdc to -52.5 Vdc
Transient:	-41.75 Vdc to -60.0 Vdc

Temperature

Office Aisle Ambient:	0°C to 50°C
Circuit Pack:	0°C to 70°C

3.2 FUNCTIONAL DESIGNATIONS

DSU2 Functional Designation

DESIGNATION	DEFINITION
ACSR	Automatic Customer Station Rearrangement
ANIF	Automatic Number Identification Failure
ASC	Announcement Storage Circuit
AVMWI	Analog Visual Message Warning Indicator
CAMA	Centralized Automatic Message Accounting
CCS	Common Channel Signaling
CDA	Call Disposition Analysis
CNAM	Caller Name Identification
DSC	Digital Service Circuit
DSP	Digital Signal Processor
DSU2	Digital Service Unit Model 2
EASC	Expansion Announcement Storage Circuit
EMI	Expansion Memory Interface
EPI	Expansion Port Interface
EPROM	Erasable Programmable Read Only Memory
FIFO	First-In First-Out
FSK	Frequency Shift Keying
IC	Integrated Circuit
ICLID	Individual Calling Line Identification
IDB	Initialization Data Block
ISTF	Integrated Services Test Function
LDSUF	Local Digital Service Unit Function
LP	Logical Processor
MFC	Multi-Frequency Compelled
MP	Module Processor
ODD	Office Dependent Database
ONI	Operator Number Identification
OSPS	Operator Services Position System
PICB	Peripheral Interface Control Bus

DESIGNATION	DEFINITION
PIDB	Peripheral Interface Data Bus
PWP	Parity Write Protect
RAF	Recorded Announcement Function
RAM	Random Access Memory
RAW	Recorded Announcement Workstation
RSW	Resident Software
SDI	Serial Data Interface
SM	Switching Module
SMP	Switching Module Processor
TDM Bus	Time-Division Multiplexed Bus
TGEN	Tone Generation
TMSR	Tone Measure
TSIU	Time Slot Interchange Unit
TTF2	Transmission Test Function - Version 2
UAP	Unit Access Port
UCI	Unified Control Interface
VBDG	Voice Band Data Generation
VDI-1	Voiceband Digital Interface - Version 1
VPA	Voice Path Assurance

3.3 FUNCTIONS

The DSU2 functions are described in section 2 of this circuit description.

3.4 CONNECTING CIRCUITS

The DSU2 is connected to the following circuits:

UNIT	SD-NUMBER
Switching Module Processing Unit (SMPU)	SD-5D040-01
Time Slot Interchange Unit 1 (TSIU 1)*	SD-5D041-01
Time Slot Interchange Unit 2 (TSIU 2)*	SD-5D045-01
Module Controller Time Slot Interchange Unit (MCTU)*	SD-5D094-01

3.5 MANUFACTURING TESTING REQUIREMENTS:

There are currently no manufacturing testing requirements for this unit.

* when office is configured with this unit.

3.6 TAKING EQUIPMENT OUT-OF-SERVICE

DSU2 circuits are taken out-of-service through commands at the MCC. All DSU2 circuit packs may be pulled from the unit without removing power from the unit.

4. REASONS FOR REISSUE

Changed and added functions. Refer to section 2.

Made changes in apparatus. Refer to section 2.

Description of Changes

Appendix 1B - Drawing Issue 2B

Appendix 2B - Drawing Issue 3B

Appendix 3B - Drawing Issue 4B

Appendix 4B - Drawing Issue 5B

Appendix 5B - Drawing Issue 6B

Appendix 6B - Drawing Issue 7B

Appendix 7B - Drawing Issue 8B

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