
DIGITAL SWITCHING SYSTEMS

**DMS-100* FAMILY
INTEGRATED BUSINESS
NETWORK SERVICE**

**BUSINESS SET, GENERAL DESCRIPTION,
INSTALLATION,
Maintenance and Ordering Information**

CONTENTS

PAGE

Reason for Reissue: This revised issue replaces the Standard issue dated 86-05-27. The revisions include the addition of Automatic Call Distribution (ACD) Sets, incorporation of Appendix 1 (Business Sets and Handsets equipped with TELADAPT* connectors) and numerous other information updates and corrections. Due to the substantial changes which require repagination and renumbering of illustrations, revision marks would not be helpful and are, therefore, not used in this Practice revision.

* DMS-100 is a trademark of Northern Telecom.

1. OVERVIEW

1.01 The available versions of the Business Set are as follows:

NT4X20AA	Business Set without Alphanumeric Display - with line cord equipped with Teladapt connectors at both ends and handset cord hardwired to the set.
NT4X20AE	Business Set without Alphanumeric Display - with line cord equipped with Teladapt connector at the set-end, spade tips at the other end, and handset cord hardwired to the set.
NT4X20AL	Business Set without Alphanumeric Display - both line cord and handset cord equipped with Teladapt connectors at both ends.
NT4X20AB	Business Set with Alphanumeric Display - with line cord equipped with Teladapt connectors at both ends and handset cord hardwired to the set.
NT4X20AF	Business Set with Alphanumeric Display - with line cord equipped with Teladapt connector at the set-end, spade tips at the other end, and handset cord hardwired to the set.
NT4X20AM	Business Set with Alphanumeric Display - both line cord and handset cord equipped with Teladapt connectors at both ends.
NT4X20AT	Business Set with Alphanumeric Display for Automatic Call Distribution (ACD) service. Equipped with headset jacks at handset side of set. Line cord and handset cord equipped with Teladapt connectors at both ends.

BUSINESS SET WITHOUT ALPHANUMERIC DISPLAY

1.02 These business sets (NT4X20AA/AL/AE) are equipped with:

- eight feature or Directory Number (DN) access keys and associated Liquid Crystal Display (LCD) indicators
- two feature keys without LCD indicators
- four fixed feature keys without LCD indicators (Vol.Up, Vol.Down, Hold, and Rls)
- a standard 12-button telephone key pad, and
- internal option switches.

1.03 All business sets use voice and “above voice band” signaling transmission over a 2-wire line. Voice and signaling are frequency division multiplexed, with binary data transmitted via absence or presence of the carrier frequency. All feature activation is via this transmission.

Feature Keys, Assignable

1.04 The feature keys can be assigned a subset of the following features:

Key Designation	Feature Description	Acronym
Auto Dial	Automatic Dialing	AUD
Auto Line	Automatic Line	AUL
Call Fwd	Call Forward	CF
Call Park	Call Park	PARK
Call Wait	Call Waiting	CWT
Conf	Conference Calls	CON
Conf3	Three-way Conference	TWC
I/C Group	Intercom Group	GIC
Intercom	Intercom Calls	ICM
Station..	Station Busy Indication	SBI
Msg Wait	Message Waiting	MWT
Make Busy	Make Busy	MSB
Override	Busy Override	EBO
Pickup	Call Pickup	CPU
Privacy	Privacy	PRV
Priv Rls	Privacy Release	PRL
Ring Again	Ring Again	RAG
Speed Call	Speed Call	SCS
Time/Date	Query Time and Date	QTD
Transfer	Call Transfer	CXR

1.05 LCD indicators associated with the feature keys support the following four key/LCD states:

FUNCTION	LCD STATE
idle or feature inactive	LCD off
active or feature active	LCD on
incoming call or feature pending	LCD flashing (60 IPM)
call on hold	LCD winking (120 IPM)

Feature Keys, Fixed

1.06 Non-optional keys on the sets provide three permanent functions; call Hold, call Release, and Volume Control.

1.07 *Hold.* The HOLD function has two modes of operation, manual and automatic. With the user engaged in a call, the call can be put on hold either by pressing the HOLD key or by pressing another DN key. In either case the DN LCD indicator changes from ON to “winking” and the user is free to answer or make another call.

1.08 *Release.* The RLS (release) key performs the same function as going on-hook, i.e. when pressed, it terminates a call. The DN LCD indicator associated with the released call changes from the ON state to the OFF state.

1.09 Volume Control. The speaker volume is controlled by two keys, VOL UP and VOL DOWN. Operating these keys incrementally increases or decreases the speaker volume during an ongoing session. The handset receiver volume is not affected in any way by these speaker volume adjustments. After session has ended, the speaker volume returns to the default value. The following adjustments to the default settings are possible:

- (a) To change the default value for voice and dial tone, press both the VOL UP and VOL DOWN keys simultaneously when the signal is present and after the desired volume level has been obtained. This causes the current volume setting to be stored as the new default value.
- (b) To change the default value of the alerting tone, press the VOL UP or VOL DOWN keys while the alerting signal sounds. Obtain the desired level in the same manner as stated above for the speaker volume. The last set value becomes the new default value.

Note: When the business set is powered down by disconnecting the loop or the power supply, the voice and dialtone volume returns to the lowest level, and the alerting tone level goes to the middle point setting when the set is reconnected.

Basic Features

1.10 Every Business Set has the following basic features:

- (a) **Automatic Prime DN selection:** allows the user to select the prime DN (i.e., the DN assigned to the 1st key) by going off-hook to answer a call without pressing a DN key.
- (b) **On-hook Dialing:** allows a call to be dialed by selecting a line and dialing the number without lifting the handset. The handset must be lifted once the called party answers.
- (c) **Listen On Hold:** allows the user, when placed on hold, to replace the handset and listen via the speaker until the other party returns to the call.
- (d) **Alerting Tones:** Warble tone sounds when telephone is on-hook, buzzer tone sounds when telephone is off-hook.

BUSINESS SET WITH ALPHANUMERIC DISPLAY

1.11 In addition to the features provided by the basic business set, the NT4X20AB, AF and AM sets include a 32-character alphanumeric LCD display which permits access to the following features:

- Called Number Display
- Calling Number Display
- Query Time and Date (QTD) Display
- Feature Programming

- Feature Usage.

Note: One feature key must be reserved for accessing the QTD display. Because an LCD indicator is not required for this feature, a feature key without an associated LCD indicator should be chosen for the QTD display function. Other features can be assigned, from the switching software, to function automatically or when called up by operating an assignable function key. The “Calling Number Display” can be assigned to be activated either at the first alerting tone, or after the handset (or handsfree option) has been picked up (or activated). The “Called Number” display is always activated automatically as dialing takes place.

ACD SET WITH ALPHANUMERIC DISPLAY

1.12 The NT4X20AT Automatic Call Distribution (ACD) business set is intended for use by attendants. It provides head-set and handset capabilities and makes use of DMS-100 switch software for incoming automatic call distribution and an optional feature for equal loading of operators. An “agent jack” (dual PJ327 type) is provided at the handset side of the set to allow connection of an agent's headset assembly. The ACD business set can be equipped with up to three 20-key/16-LCD indicator strip add-on units but it cannot be provided with a Handsfree unit. The ACD set always requires alternate (external) power. If the alternate power supply fails, the ACD set will not be operational (no “Fail to POTS”). The following headset is recommended for use in conjunction with the ACD set:

- Plantronics Supra, HS 0552-1

1.13 The NT4X20AT includes a 32-character alphanumeric LCD screen which permits access to the following features:

- Called Number Display (BCS-28)
- Calling Number Display
- Query Time and Date (QTD) Display
- Feature Programming
- Feature Usage.

Note: One feature key is required for accessing the QTD display. Because an LCD indicator is not needed for this feature, a feature key without an associated LCD indicator should be chosen for the QTD display function. Other features can be assigned, from the switching software, to function automatically or when called up by operating an assignable function key. The “Calling Number Display” can be assigned to be activated either at the first alerting tone, or after the handset (or handsfree option) has been picked up (or activated). The “Called Number” display is always activated automatically as dialing takes place.

20-BUTTON ADD-ON MODULE

1.14 The NT4X20AC is a 20-key/16-LCD add-on module which extends the capability of a Business Set by adding more feature key/LCD indicator strips. It features two rows of 10 keys; the top two keys in each row are not

equipped with LCD indicators and are used for features which do not require LCD indication (example: QTD key). This add-on unit attaches to the right side of the business set if only one add-on unit is provided, or to the end of a row of 1 or 2 add-on units (the NT4X20AC is an end-unit which does not allow further addition of any equipment at the right hand side of the unit).

Note: The NT4X20AC is rated A&M (additions and maintenance). Spare parts for this module can still be ordered in accordance with Table 5-B.

1.15 The NT4X20AG is similar to the NT4X20AC add-on unit in appearance and arrangement of key/LCD indicator strips, but can be used either as an extendable add-on unit or as an end-unit.

AUTO-ANSWERBACK (AAB) KIT

1.16 The NT4X20AJ Kit contains one NT4X21AD module which mounts in the Business Set to provide the AAB feature, and two (2) P0180923 mounting screws. The Business Set must be equipped with a Handsfree Unit when this feature is assigned. This kit cannot be used with the NT4X20AT ACD business set.

HANDSFREE UNIT

1.17 The NT1L00AA or NT1L05AA Handsfree Units (HFU) are identical in function to the Companion and Logic Handsfree units, and are designed for connection to the left side of the Business Sets. Provision is made for:

- accepting incoming calls on either the HFU or the associated business set
- transferring calls between the HFU and the associated business set
- dialing outgoing calls with the handset either on-hook or off-hook
- automatic cutoff of the HFU when the handset is lifted off-hook for handset operation.

1.18 Controls on the face of the HFU are as follows:

- **Volume control:** to set the volume of the received signal on the HFU speaker.
- **Indicator lamp:** monitors the operating mode of the unit, i.e. the lamp is on when the unit is in the transmit mode, and off when the unit is in the receive mode.
- **ON key:** used to switch on the unit. The key must be depressed momentarily to answer an incoming call with the handset on-hook or before commencing on-hook dialing. The key must be held depressed until the handset is placed on-hook to transfer from handset to handsfree operation. The key may be held depressed to hold a call on the unit with both transmission and reception cut off (Note).
- **OFF key:** used to terminate a call on the HFU (Note).
- **MUTE key:** used to cut off transmission without affecting reception (Note).

Note 1: On handsfree units designed for bilingual or international use (example: NT4X05AA), keys are designated with icons. Refer to Fig. 1-1.

Note 2: The handsfree unit cannot be added to an ACD business set (NT4X20AT).

Fig. 1-1
Handsfree Unit Key Designations

2. INSTALLATION

INTERCONNECTIONS

2.01 Each Business Set is equipped with a 6-conductor line cord for connection to standard telephone terminal connectors as follows:

- NT4X20AA, NT4X20AB, NT4X20AL, NT4X20AM, and NT4X20AT sets are equipped with NE-D6QT-87 Teladapt connectors
- NT4X20AE and NT4X20AF sets are equipped with NA 800 905 spade tips

2.02 The conductors in the line cords are color coded for termination as given in Table 2-A.

2.03 For block diagrams of the interconnections of the business sets refer to:

Fig. 2-1 Business set without alphanumeric display

Fig. 2-2 Business set with alphanumeric display

Fig. 2-3 ACD business set with alphanumeric display

**Table 2-A
BUSINESS SET CORD CONNECTIONS**

LEAD COLOR	LINE	CONNECTIONS TO (Note 1)	
		ALTERNATE POWER SUPPLY (Notes 2,3)	HANDSFREE UNIT POWER SUPPLY
Green	Tip		
Red	Ring		
Yellow		AP+	
Black		VSS	
Blue			HFRET
White			HFAP+
Yellow	Jumper (Note 4)	AP+	VBB

Note 1: Quick-Connect wire terminal locations are given in Fig. 2-13 (for basic set), Fig. 2-14 (for display set), and Fig. 2-15 (for ACD set).

Note 2: Local ac power supplies (Plug-in transformer) must only be used with a 2.1 m (7 ft) linecord and a T-adaptor. Remote ac power is not recommended.

Table Continued -----

Table 2-A Continued
BUSINESS SET CORD CONNECTIONS

Note 3: Wire remote (closet) power supply 24 V dc secondary leads from the nearest outlet to the junction box or Teladapt jack serving the unit to be powered. The following restrictions apply:

- Separate cables to each set (or workstation) must be used, only containing Tip, Ring and dc power supply leads for that set (or workstation). No paralleling of pairs to reduce line resistance is permitted.
- Distribution of closet power to a number of sets in the same cable is not permitted because noise pickup and crosstalk can occur between power wires.
- A separate, isolated power supply circuit is required for each set (or workstation).

In a “fully loaded” situation (display and three add-ons), the maximum allowable run-lengths and minimum wire gauges for these supply lead pairs are as follows:

- 22 or 24 AWG run-length maximum = 76 m (250 ft) (.0324 Ohm/ft or .0514 Ohm/ft)*
- 26 AWG run-length maximum = 46 m (150 ft) (.0820 Ohm/ft)
- Tinsel-wire line cord maximum = 2.1 m (7 ft) (1.7 Ohm/ft)

The maximum permissible power feed resistance (combined resistance of all feed wiring) is 25 Ohm. If any doubt as to resistances and/or wire type used exists, the total resistance of the supply lead pair (total resistance of both wires end-to-end) should be measured. The above figures assume a standard seven foot line cord. If a longer line cord is used, the additional line cord resistance has to be considered and the total allowable run-length of power feed wiring must be reduced accordingly.

*With the exception of the tinsel-wire linecord, which has a very high resistance, the resistance of the wiring between the power supply and the telephone is not the sole limiting factor, but the noise pickup and crosstalk susceptibility must also be considered. Consequently, the power feed line length cannot be extended beyond 76 m (250 ft) even if the wire size is increased from 24 AWG to 22 AWG, however, the 22 AWG could be used where line resistance must be reduced due to a longer than 2.1 m tinsel-wire linecord.

Note 1: A spade tipped jumper P013E419 can be run from the Handsfree unit through the plug adaptor to the AP+ terminal on the business set circuit board to provide power for one add-on unit, or for the alphanumeric display portion of one business set in some cases (Fig. 2-11).

Fig. 2-1
Block Diagram - Business Set without Alphanumeric Display - Interconnections

Fig. 2-2
Block Diagram - Business Set with Alphanumeric Display - Interconnections

Fig. 2-3
Block Diagram - ACD Business Set with Alphanumeric Display - Interconnections

**POWER SUPPLY
ARRANGEMENTS**

2.04 Where loop powering is not sufficient, alternate power supplies must be provided. Alternate power can be obtained through a remote (or closet) dc power unit or through a local plug-in type ac transformer with ac output or dc output. Wiring resistance requirements are noted in the preceding Table 2-A. Fig. 2-4 illustrates a wiring schematic for the power supply arrangements. The following text provides more detail.

**Remote (Closet)
Powering**

2.05 Supplying ac from a closet power unit with rectification at the business set *is not* recommended as this will generate excessive noise in the line.

2.06 Two closet dc power supply units are recommended:

- (a) Shumway; No.TBA, 110 V ac input, 24 V dc, 200 mA outputs.
- (b) NPS 50220-07.L8; CPC A0352921 (1 circuit), 110 V ac input, 24 V dc, 250 mA output.

2.07 When using the closet power supply, the following points should be observed:

- A separate cable, containing Tip, Ring and power supply leads, is required for each business set (or workstation).
- Each business (or workstation) is to be connected to a different power supply circuit.
- run length between closet power supply and business set must not exceed 76 m (250 ft) of 24 or 22 AWG wire, or 46 m (150 ft) of 26 AWG wire.
- Wire pairs should not be paralleled to reduce feed resistances.

**Local Transformer
Powering**

2.08 A plug-in type transformer may be used for local powering. This transformer must be within the immediate area of the business set or add-ons it powers and no extension cords of any sort are allowed.

2.09 The NPS50220-08 L.4 (A329941) Power Supply equipped with a NE267QA Duplex (or T-) Adapter is provided in conjunction with the handsfree unit. This power supply plugs into a 110 V ac wall-outlet and delivers 375 mA of 16 V ac from an insulated secondary winding. The following points should be observed:

- Each business set (or workstation) must have a separate, individual power supply.
- The linecord used with the business set must not be longer than 2.1 m (7 ft.) when this power supply is used.
- The secondary power supply lead between the plug-in transformer and the T-adapter cannot be extended and is the limiting factor in the distance at which the transformer can be located from the telephone.

2.10 The NPS50220-07.L8 single circuit 24 V dc power supply shown earlier under “remote powering” can also be used as a local power supply, in which case the distance and wire gauge requirements listed under “remote (closet) powering” apply.

Fig. 2-4
Wiring Schematic for Alternate Power Supply Arrangements

2.11 A general listing of business set, ACD set, or add-on unit powering requirements and possible combinations of loop powering and alternate power supplies is given in Table 2-B.

Table 2-B
ALTERNATE POWER SUPPLY REQUIREMENTS.

Caution: Where non-standard power arrangements are made (e.g. supplying a display unit or one 20-button add-on unit through a fly-lead from the Handsfree unit), make certain that the power supply lead which would normally carry the power to those units is removed from the terminal (AP+) within the unit concerned, properly insulated, and safely stored inside the set. Failure to do so may cause circuit board damage.

Set Configuration	Alternate Power Required
Business Set without Alphanumeric Display	No

Table Continued -----

Table 2-B Continued
ALTERNATE POWER SUPPLY REQUIREMENTS.

Set Configuration	Yes	Alternate Power Required
Business Set with Alphanumeric Display	Yes	If loop is over 250 Ohm, a 24 V dc local power supply or a remote 24 V dc closet power supply is required.
ACD Business Set with Alphanumeric Display	Yes	A 24 V dc local power supply or a remote 24 V dc closet power supply is always required. This set is inoperative when alternate power is not available.
1 Add-On Module	Yes	If loop is over 250 Ohm, or if added to a Business Set with Alphanumeric Display, a 24 V dc local power supply or a remote 24 V dc closet power supply is required.
2 or 3 Add-On Modules	Yes	A 24 V dc local power supply or a remote 24 V dc closet power supply is always required.
Handsfree Unit (HFU)	Yes	Requires either a 16 V ac, a 24 V dc local power supply or a remote 24 V dc closet power supply.
HFU and Add-On Modules	Yes	One Add-On Module or a Business Set with Alphanumeric Display can be powered from the HFU local power supply through a fly-lead. If there are more than one add-on modules, they must be powered through a 24 V dc local or remote power supply.

Business Sets without Alphanumeric Display

2.12 Illustrations: The following schematic illustrations give the various possibilities for powering the business sets without alphanumeric display:

- Fig. 2-5 Business Set with HFU and one to three add-on units: Powering with loop resistance less than or equal to 250 Ohm.
- Fig. 2-6 Business Set with HFU and one to three add-on units: Powering with loop resistance greater than 250 Ohm.
- Fig. 2-7 Business Set with HFU and one add-on unit: Alternate power connections.

2.13 Illustration Notes: The following notes apply to Fig. 2-5, 2-6, and 2-7:

Note: 1 Refer to Chart 2-1, Table 2-C, Fig. 2-13 for further information on installation, option switch settings, and wiring details respectively.

Note: 2 Refer to Chart 2-2, Table 2-D, and Fig. 2-16 for further information on installation, option switch settings, and wiring details respectively.

Note: 3 When powering for only one add-on unit is required and the loop resistance is 250 Ohm or less, set switch S2 in the business set to LP/HI, and switch S2 in the add-on unit to LP. Do **not** connect alternate power to the AP+ and VSS leads in that case.

Note: 4 If the loop resistance is over 250 Ohm and only one add-on unit is equipped, power for that one add-on unit can be supplied through a fly lead from the handsfree unit.

Note: 5 The maximum remote (closet) power feed resistance (combined resistance of all feed wiring) is 25 Ohm, and the minimum supply voltage at the set (measured at the jack under full load) is 18 V dc. The 25 Ohm power feed resistance measurement assumes a standard seven foot line cord. If a longer line cord is used, the additional line cord resistance has to be subtracted from the maximum power feed resistance. Local ac power supply must only be used with a 2.1 m (7 ft) linecord and a T-adapter.

Note: 6 A separate and isolated power feed is required where loop conditions or configurations dictate an auxiliary feed:
(a) for each business set installation (or workstation),
(b) for each handsfree unit installed, even if this means a second power supply (see also Note 7).

Note: 7 Handsfree power may also be supplied from an external remote (closet) or local (plug-in) 24 V dc source, same as the type being used for the 20-button add-on; however, since both power consumption and installation cost are increased with a dc feed, local ac powering should be used wherever possible. This alternate power supply option requires the same jumper arrangement as given in Note 8.

Note: 8 Install a yellow 26 AWG spade tip jumper (P013E419) between terminal AP+ in the Business Set and terminal VBB in the Handsfree Unit to provide power for one 20-button add-on unit from the Handsfree Unit. Observe caution note in Table 2-B.

Fig. 2-5
Business Set without Alphanumeric Display, equipped with HFU and One to

Three Add-On Units: Powering when Loop-Resistance is less than or equal to 250 Ohm

Fig. 2-6

Fig. 2-7

Business Set without Alphanumeric Display, equipped with HFU and One to Three Add-On Units: Powering when Loop-resistance is greater than 250 Ohm

Fig. 2-8

**Business Set without Alphanumeric Display, equipped with HFU and One Add-On Unit:
Alternate Power Connections for all Loop Lengths****Business Sets with
Alphanumeric Display**

2.14 Illustrations: The following schematic illustrations give the various possibilities for powering the business sets with alphanumeric display:

Fig. 2-8	Business Set with Alphanumeric Display, HFU, and one to three add-on units: Powering with loop resistance less than or equal to 250 Ohm.
Fig. 2-9	Business Set with Alphanumeric Display, HFU, and one to three add-on units: Powering with loop resistance greater than 250 Ohm.
Fig. 2-10	Business Set with Alphanumeric Display, HFU, and one add-on unit: Alternate power connections with loop resistance less than or equal to 250 Ohm.
Fig. 2-11	Business Set with Alphanumeric Display, HFU, and one add-on unit: Alternate power connections with loop resistance greater than 250 Ohm.
Fig. 2-12	ACD Business Set with Alphanumeric Display and one to three add-on units: Alternate power connections always required

2.15 Illustration Notes: The following notes apply to Fig. 2-8, 2-9, 2-10, 2-11, and 2-12:

Note: 1 Refer to Chart 2-1, Table 2-C, and Fig. 2-14 for further information on installation, option switch settings, and wiring details respectively.

Note: 2 Refer to Chart 2-2, Table 2-D, and Fig. 2-16 for further information on installation, option switch settings, and wiring details respectively.

Note: 3 Powering of only one 20-button Add-on unit from the Handsfree unit is possible if loop resistance is 250 Ohm or less; refer to Fig. 2-10.

Note: 4 Powering of the alphanumeric display from the Handsfree unit when loop resistance is greater than 250 Ohm is possible; refer to Fig. 2-11.

Note: 5 The maximum remote (closet) power feed resistance (combined resistance of all feed wiring) is 25 Ohm, and the minimum supply voltage at the set (measured at the jack under full load) is 18 V dc. The 25 Ohm power feed resistance measurement assumes a standard seven foot line cord. If a longer line cord is used, the additional line cord resistance has to be subtracted from the maximum power feed resistance. Local ac power supply must only be used with a 2.1 m (7 ft) linecord and a T-adapter.

Note: 6 A separate and isolated power feed is required where loop conditions or configurations dictate an auxiliary feed:

(a) for each business set installation (or workstation),

(b) for each handsfree unit installed, even if this means a second power supply (see also Note 7).

Note: 7 Handsfree power may also be supplied from an external remote (closet) or local (plug-in) 24 V dc source, same as the type being used for the 20-button add-on; however, since both power consumption and installation cost are increased with a dc feed, local ac powering should be used wherever possible. This alternate power supply option requires the same jumper arrangement as given in Note 8.

Note: 8 Install a yellow 26 AWG spade tip jumper (P013E419) between terminal AP+ in the Display Phone and terminal VBB in the Handsfree Unit to provide power for one 20-button add-on unit, or (when the loop resistance is greater than 250 Ohm) the LCD screen only, from the Handsfree Unit. Observe caution note in Table 2-B.

Fig. 2-9
Business Set with Alphanumeric Display, HFU, and One to Three Add-On Units:
Powering when Loop-Resistance is less than or equal to 250 Ohm

Fig. 2-10
Business Set with Alphanumeric Display, HFU, and One to Three Add-On Units:
Powering when Loop-Resistance is greater than 250 Ohm

Fig. 2-11
Business Set with Alphanumeric Display, HFU, and One Add-On Unit:
Alternate Power Connections when Loop-Resistance is less than or equal to 250 Ohm

Fig. 2-12
Business Set with Alphanumeric Display and one Handsfree Unit:
Alternate Power Connections when Loop-Resistance is greater than 250 Ohm

Fig. 2-13

ACD Business Set with Alphanumeric Display and one to three add-on units: Alternate power connections always required

WIRING AND SWITCH SETTINGS

2.16 The following charts, tables and illustrations give instructions for installing and connecting Business Sets and Add-On Units, including the addition of an Answer Back Module to new or existing equipment.

Chart 2-1

INSTALL A BUSINESS SET

WARNING: *This procedure applies to NT4X20AA, NT4X20AB, NT4X20AL, NT4X20AM, NT4X20AE, NT4X20AF, NT4X20AT Business Sets.*

STEP PROCEDURE

- 1 Proceed to Step 7 unless
 - (a) settings of internal switches in the set need to be changed (ref. Table 2-C and Fig. 2-13 & 2-14), or
 - (b) an alternate power supply is required (ref. Table 2-B). Alternate power is always required for the ACD Business Set (NT4X20AT).

- 2 Remove the faceplate from the Business Set by inserting an NS-16750L3 releaser or equivalent in the hole located in the front of the set.

- 3 Remove the two screws holding the cover and remove the cover from the set.

- 4 Set the internal switches according to Table 2-C and Fig. 2-13 and 2-14 (Fig. 2-15 for the NT4X20AT ACD set) where required

Note: It may be necessary to lift the key-pad/push-button assembly to access the switches.

- 5 Install alternate power supply where required.

- 6

Caution: Special precautions are necessary when powering up an ACD Set (NT4X20AT). Refer to Note at the end of this Chart for specific instruction concerning the ACD Set.

- 7 Replace cover and faceplate.

- 8 Designate feature keys using designation tabs.

- 9 Install plastic caps.

- 10 Perform station ringer test per Chart 3-1.

Chart Continued -----

Chart 2-1 Continued
INSTALL A BUSINESS SET

STEP PROCEDURE

11

Note: The following must be observed when installing an ACD Set:

Applying power. Either the alternate power supply and loop-power must be applied simultaneously (that means, insert linecord into the ACD Set *after* the other end of the linecord has been plugged into the connecting box *and* the power supply), or the loop voltage must be applied first and the alternate power source second (that means plugging the linecord into the connecting box before inserting the plug-in transformer into the wall-receptacle). Never apply alternate power first and loop power second. If this is not observed, the following will happen:

- Keypad operation will be locked out
- Speaker volume controls will be disabled.

Should this condition exist, unplug the linecord *at the ACD Set* momentarily and then reconnect it. This will clear the problem.

Tip/Ring polarity reversal. If the ACD Set was installed with wrong Tip/Ring polarity but was powered up in the correct sequence, the set may work with the following defects:

- Keypad operations will be locked out
- Poor acoustics due to absence of AGC control voltage (LV)
- Loop current detector in linecard would not be able to detect set presence (if BCS supported).

The only time above condition may happen is at an initial set installation or during wiring rearrangements at the Distributing Frame when polarity may be reversed inadvertently. To correct the problem, after polarity has been corrected, simply disconnect linecord at the set momentarily and reconnect it in the same fashion as when power was applied in the incorrect sequence. This will clear the problem.

As a general precaution, if there are customer complaints about a malfunctioning ACD set (including ESD discharges in dry environment), check (and correct, if necessary) polarity and try the linecord unplugging and reconnecting (at the set) routine before calling repair or returning any set to the factory.

Internal Option Switches

2.17 Business sets without alphanumeric display have three option switches: S1, S2, and S3. These switches perform the following functions:

- **The S1 Switch** is used to set the address of the set. Address 0 is reserved for the main set, address 4 is reserved for possible extensions. Presently, extension sets are not in use, and are not supported.
- **The S2 Switch** has two sections; one is used to adjust the set to loop

power (LP) or alternate power (AP) supply conditions, the other is used to adjust the set to loop powering the set only (LO), or for loop powering one set and one 20 button add-on unit (HI).

- **The S3 Switch** is used to select the operating mode of the set. In the MAIN set position, the set is a 900 Ohm ac impedance and draws loop current. In the EXTension position, the set is a high impedance and does not draw loop current.

2.18 Business sets with alphanumeric display have four option switches: S1, S2, S3, and S4. These switches perform the following functions:

- **The S1 Switch** is used to select the operating mode of the set. In the MAIN position, the set is a 900 Ohm ac impedance and draws loop current. In the EXTension position, the set is a high impedance and does not draw loop current.
- **The S2 Switch** is used to change the loop current drawn by the set. When set to SHORT (loop length less than or equal to 250 Ohm), both the set and the display are loop powered; when set to LONG (loop length greater than 250 Ohm), an alternate power supply is required to operate the alphanumeric display.
- **The S3 Switch** is used to test the display screen. During normal operations (i.e. when set is not in the display screen test mode), both toggles must be in the OFF position. For further information concerning test routines, refer to Part 3 (Verification Procedures).
- **The S4 Switch** is used to set the address of the set. Address 0 is reserved for the main set, address 4 is reserved for possible extensions. Presently, extension sets are not in use, and are not supported.

2.19 Option Switch Settings: For a listing of internal option switch settings for business sets, refer to Table 2-C. Associated illustrations are given in Fig. 2-13, and 2-15.

2.20 20-Key/16-LCD Indicator Add-on modules are equipped with two option switches: S1 and S2. These switches perform the following functions:

- **The S1 Switch** is used to set the address of the 20-button add-on unit. Addresses 1, 2, and 3 are reserved for the respective add-on units to a main set; addresses 5, 6, and 7 are reserved for add-on units 1, 2, and 3, respectively, to an extension set. Presently, extension sets are not in use, and are not supported.
- **The S2 Switch** is used to switch the power supply for the add-on unit between loop power (LP) and alternate power (AP) from an external 24 Vdc supply.

2.21 Option Switch Settings: For a listing of internal option switch settings for add-on modules refer to Table 2-D and Fig. 2-16.

**Table 2-C
BUSINESS SET SWITCH SETTINGS**

SWITCH	SETTINGS
<i>Business Set without Alphanumeric Display (NT4X20AA, AE, and AL)</i>	
<i>SWITCH 1 (Address)</i>	
ADDRESS Zero:	Set A0 to OFF Set A1 to OFF Set A2 to OFF
<i>SWITCH 2 (Powering)</i>	
HI-LO	<ul style="list-style-type: none"> • Set to LO regardless of loop length if no add-ons are equipped or if add-ons are alternately powered • Set to HI if loop is less than or equal to 250 Ohm and only one loop powered add-on is equipped
AP-LP	<ul style="list-style-type: none"> • Set to LP if set is loop powered • Set to AP if set is alternately powered (not normally the case)
<i>SWITCH 3 (Impedance)</i>	
MAIN/EXT	<ul style="list-style-type: none"> • Set to MAIN if set is loop powered. Provides 900 Ohm termination impedance.
<i>Business Set with Alphanumeric Display (NT4X20AB, AF, AM, and AT)</i>	
<i>SWITCH 4 (Address)</i>	
ADDRESS Zero:	Set A0 to OFF Set A1 to OFF Set A2 to OFF
<i>SWITCH 2 (Powering)</i>	
SHORT-LONG	<ul style="list-style-type: none"> • Set to SHORT if both the set and the digit display are loop powered and the loop resistance is less than or equal to 250 Ohm. • Set to LONG if only the set portion is loop powered and the loop resistance is greater than 250 Ohm. Automatically selects the required alternate power for the alphanumeric display section, if an alternate power unit is supplied. • The alphanumeric display can also be powered from a Handsfree unit by connecting a fly lead from the VBB terminal in the Handsfree unit to the set's AP+ terminal, except for ACD sets. Must always be set to LONG when set is an ACD set.
<i>SWITCH 1 (Impedance)</i>	

Table Continued -----

Table 2-C Continued
BUSINESS SET SWITCH SETTINGS

SWITCH	SETTINGS
MAIN-EXT	• Set to MAIN if set is loop powered to provide 900 Ohm termination impedance. Set to EXT when set is an ACD set.
<i>SWITCH 3 (Test mode)</i>	
LTS-OFF	• Set to OFF for normal (other than test mode) operation.

Fig. 2-14
Business Set without Alphanumeric Display (NT4X20AA, AE, and AL):
Wiring and Option Switches

Fig. 2-15
Business Set with Alphanumeric Display (NT4X20AB, AF, and AM):
Wiring and Option Switches

Fig. 2-16
ACD Business Set with Alphanumeric Display (NT4X20AT):
Wiring and Option Switches

Chart 2-2

INSTALL A 20-BUTTON ADD-ON MODULE

WARNING: This procedure applies to NT4X20AC and NT4X20AG add-on modules. The NT4X20AC unit is no longer manufactured and is rated A&M (additions and modifications only).

STEP PROCEDURE

- 1** Perform one of the following:
 - (a) If the first add-on is being installed, remove the cover and faceplate from the Business Set, or
 - (b) if a second or third add-on is being installed, remove the cover from the preceding add-on.
 - 2** Remove the cover from the new add-on.

Note: In the add-on units, the printed circuit boards are attached to the top cover and dial pad; components are accessible from the underside.
 - 3** Remove the filler plate from the right side of the set or existing add-on.
 - 4** Lock the new add-on to the set or existing add-on, using the locking device attached to the new add-on wiring harness.
 - 5** Extend the add-on module harness into the preceding set or add-on, and plug the harness into P2.
 - 6** Set the switches on the new add-on according to Table 2-D and Fig. 2-16.
 - 7** Replace the covers and faceplates on the set and add-on module(s).
-

Table 2-D
20-BUTTON ADD-ON MODULE SWITCH SETTINGS

SWITCH	SETTING			KEY NUMBERS
				CONTROLLED BY SWITCH SETTINGS
SWITCH 1 (Address)				
First Add-on Unit:	Set <i>A0 To ON</i>	Set <i>A1 To OFF</i>	Set <i>A2 To OFF</i>	10 - 29
Second Add-on Unit:	Set <i>A0 To OFF</i>	Set <i>A1 To ON</i>	Set <i>A2 To OFF</i>	30 - 49
Third Add-on Unit:	Set <i>A0 To ON</i>	Set <i>A1 To ON</i>	Set <i>A2 To OFF</i>	50 - 69
SWITCH 2				
AP-LP	<ul style="list-style-type: none"> • Set to AP if alternate power is used. • Set to LP if loop power is used. 			
<p>Note: Set to LP if the add-on unit is loop powered. This is used only as a first or only add-on to a basic set on loops less than or equal to 250 Ohm. For the ACD set (NT4X20AT, Fig. 2-12), the S2 switch must always be set to AP.</p> <p>Set to AP if the add-on unit is alternately powered for all remaining applications; this does require an alternate power supply.</p> <p>One, and only one add-on unit can be powered if used in combination with a basic set and a Handsfree unit (or a set with alphanumeric display on a loop with less than or equal to 250 Ohm, Switch 2 set to SHORT and having a Handsfree unit) by connecting a fly lead between the Handsfree unit VBB terminal and the MAIN set's AP+ terminal.</p>				

Fig. 2-17
20-Key/16-LCD Indicator Add-on Unit - Connector and Option Switches

Chart 2-3

INSTALL AN NT1L00AA OR NT1L05AA HANDSFREE UNIT

STEP PROCEDURE

- 1 Remove the faceplate from the Business Set by inserting an NS-16750L3 releaser or equivalent in the hole located in the front of the set.
- 2 Remove the two screws holding the cover and remove the cover from the set.
- 3 Remove the filler plate from the left side of Business Set.
- 4 Lock the Handsfree unit and set together using the locking device attached to the wiring harness.
- 5 Extend the Handsfree unit wiring harness into the set and insert the plug into jack P3. If one add-on unit or one display unit is to be powered from the Handsfree unit, continue with Step 6, otherwise proceed to Step 10.
- 6 Loosen three (3) retaining screws in the bottom of the Handsfree unit.
- 7 Remove the cover from the Handsfree Unit (HFU).
- 8 Connect one end of a double spade tipped jumper (yellow insulation) to the VBB terminal in the Handsfree unit (Fig. 2-17), run the yellow lead through the HF unit plug adaptor and connect the other end to the AP+ (or J4F) terminal in the Business Set.
- 9 Reinstall Handsfree unit cover. Reinsert three retaining screws in bottom of Handsfree unit and tighten securely.
- 10 Inspect the line cord and hookswitch wiring to ensure that the leads are on the proper connectors as follows:

Line Cord Lead Color Codes

White (W)
 Blue (BL)
 Green (G)
 Red (R)
 Yellow (Y)
 Black (BK)

Connectors on Circuit Board

HFAP+
 HFRET
 TIP
 RING
 AP+
 VSS

Chart Continued -----

Chart 2-3 Continued

INSTALL AN NT1L00AA OR NT1L05AA HANDSFREE UNIT

STEP PROCEDURE

Hookswitch Lead Color Codes

Connectors on Circuit Board

Slate/White (S/W)

HF2

Slate (S)

HS

Slate/Blue (S/BL)

HS1

Slate/Brown (S/BR)

MIC-

Green (G)

VSS(1) (Note)

Slate/Yellow (S/Y)

MIC-HS

Slate/Green (S/G)

HF1

11 Replace the cover and faceplate on the set.

12 Install the Handsfree unit power supply.

Note: Terminal VSS on business sets without alphanumeric display, terminal VSS1 on business sets with alphanumeric display.

Fig. 2-18
Handsfree Unit (HFU) Circuit Board and Wiring

Chart 2-4

INSTALL AN NT4X20AJ AUTO ANSWERBACK KIT

Caution: 1 Do not connect power to equipment until after the NT4X21AD unit is installed. Where a unit is added to existing (already in service) equipment, power supplies to such equipment must be removed prior to opening of sets to avoid damage to equipment and/or shock hazards.

Caution: 2 When the LCD screen or one Add-on unit is powered via a fly-lead from the Handsfree unit, make certain that local or remote dc power is not added to the set. If dc power has to be added, the yellow fly-lead connecting the VBB terminal in the handsfree unit to the AP+ terminal in the business set must be removed prior to supplying dc power. Double powering will cause damage to circuit boards and equipment (refer to Fig. 2-7, 2-10, 2-11, and 2-16).

STEP PROCEDURE

- 1 Remove the faceplate from the Business Set by inserting an NS-16750L3 releaser or equivalent in the hole located in the front of the set.
 - 2 Remove the two screws holding the cover and remove the cover from the set.
 - 3 Loosen three (3) retaining screws in the bottom of the Handsfree unit.
 - 4 Remove the cover from the Handsfree Unit (HFU).
 - 5 Install the Auto Answerback Module in the telephone set (Fig. 2-18).
 - 6 Connect fly-leads as shown in Fig. 2-18 and run through the HF unit plug adaptor into the Business Set.
 - 7 Connect the Auto Answerback Module as shown in Table 2-E and Fig. 2-18.
 - 8 Replace the covers and faceplates on the Business Set and the Handsfree Unit, and tighten all retaining screws.
-

Table 2-E
CONNECT THE AUTO ANSWERBACK MODULE

AUTO ANSWERBACK MODULE LEADS	BUSINESS SET	CONNECT TO HANDSFREE UNIT
W-O	DBUS	
W-BL	DSTR	
W-G	DCLK	
Y-BL		AAB
G	HF1	
O-R		VBB1
R-O		VBB
R-BL		+ 12V
BK-W		VSS

Fig. 2-19
Auto Answerback (AAB) Module - Installation and Wiring

INSTALLING THE ACD SET

2.22 The ACD business set NT4X20AT is provided as a factory assembled unit. Modification of regular NT4X20 business sets for ACD service should not be attempted in the field, as various items are needed which are not normally shipped as separate details, and some tools required may not be available to the installer. The ACD set uses as its base the NT4X20AM business set with alphanumeric display (line and handset cords equipped with Teladapt connectors at both ends) and has the following additions:

- One ACD Adapter (daughter-) board NT4X21AF is fastened to the metal chassis and connected to the NT4X21AB main circuit board.
- One Filler Plate Jack Assembly NT4X2027 replaces the standard filler plate which cannot be equipped with the necessary headset jacks.

2.23 The minimum ACD feature software requirement is BCS22.

2.24 For information purposes and a view of the internal wiring arrangement, refer to Fig. 2-19. Because the ACD set is equipped with Teladapt connectors for both the handset and line cords, internal wiring is not normally required at the job site. The set would have to be opened only when add-on units are to be attached or when modifications to the headset jack assembly are called for.

Fig. 2-20
ACD Business Set with Alphanumeric Display (NT4X20AT) - Circuit Board Assembly and
Wiring (always Factory assembled and wired)

3. VERIFICATION PROCEDURES

LOOP CHECK

3.01 Loop and linecard tests must be performed at the Central Office (ref. 297-2011-180). It is assumed that loops and linecards have been checked out prior to the installation of any business sets.

3.02 Verify that the loop resistance is less than or equal to 1230 Ohm, and that the dB loss is less than or equal to 24 dB at 8 kHz. To guarantee operation of a particular configuration, the 8 kHz attenuation should be measured when all terminals and add-ons are installed. If this is not feasible, an allowance of 0.5 dB at 8 kHz should be made for each additional terminal or add-on placed on the loop.

POLARITY CHECK

3.03 The DMS-100 Family business sets are polarity sensitive. Only if problems arise when the set is to be put into service, perform the following steps:

- (a) If the set does not respond (no dial tone), reverse tip and ring leads.
- (b) If tip and ring lead reversal does not solve the problem, change the set.
- (c) If the set still fails, call the Local Repair Service Bureau to have the appropriate diagnostics tests (loop, linecard, station ringer test software check, etc.) performed.
- (d) After the equipment has passed all tests, verify that the loop resistance remains at less than or equal to 1230 Ohm, and that the dB loss remains less than or equal to 24 dB at 8 kHz.

STATION RINGER TEST

3.04 The Station Ringer Test (SRT) tests the hardware of the DMS-100 Family business sets and can be performed by the installer or repairman at the site with no involvement of the Central Office personnel.

ACD Sets

3.05 The Station Ringer Test can be activated on an ACD set *only* if that set has a Prime Directory Number (PDN) key because the test requires dialing of the access number from the set to be tested. If the ACD set is software programmed for “call originations denied,” the test cannot be performed for that set.

Test Set-up

3.06 With the handset on hook and all LCD indicators off, press the prime directory number (prime DN) key and dial the 3 to 14 digit access code. The access code consists of a one to seven digit number which is assigned by the telephone company according to local preferences, followed by the last two to seven digits of the prime DN assigned to the telephone to be tested. In North America, the access code usually consists of the number 57, followed by the last five digits of the prime DN. If the required digits are dialed incorrectly, a REORDER tone will sound which makes it necessary to press the RELEASE key and start again. If all digits are correct, all LCD indicators at the set light up and the dialed digits are cleared from the display. The test can now proceed in

accordance with Chart 3-1.

Note: The system will not attempt to restore any LCD to its pre-test state. The LCDs will be OFF at the end of the test, with features in the same state as before the test. A background audit restores all feature indicators at its next occurrence (audit intervals are switch and load related). Any newly activated features after termination of the test procedure will be indicated normally. No incoming calls can be received for the duration of a Station Ringer Test. In order to prevent prolonged line blockages, this test is limited to a 7 minute interval after which the line will automatically be restored to normal and the test is terminated.

Chart 3-1
STATION RINGER TEST - KEY SEQUENCES

Note 1: Perform operations in the order as given in this Chart. Operate key or switch as given in the “Key or Switch” column. The response must be as given in the “Response” column. Each key or switch need only be operated momentarily. During the Liquid Crystal Display indicator (LCD) tests the LCD indicators remain ON only for as long as the associated key remains pressed. For identification of Keys and LCD indicators refer to Fig. 3-1.

Note 2: The business set with alphanumeric display has a 32-digit LCD screen, but only 12 positions on the lower line will be filled with digits during the test, while the remainder of the screen remains blank.

Note 3: If 20-key/16-LCD indicator add-on units are equipped, repeat previous 10 operations for each key/LCD indicator strip on each add-on unit before proceeding. On the add-on units, the LCD responses to the key-pressing differ from the ones at the telephone as follows:

The indicators associated with the following keys turn ON while the key is being pressed (Refer to Fig. 3-1 for Key and LCD numbering scheme):

B10 to B17, C20 to C27, D30 to D37, E40 to E47, F50 to F57, and G60 to G67.

The following indicators turn ON while the remaining keys are being pressed as given in the following listing:

Key B18: LCDs associated with keys B10 and B17 turn ON
Key B19: LCDs associated with keys B11 and B17 turn ON
Key C28: LCDs associated with keys C20 and C27 turn ON
Key C29: LCDs associated with keys C21 and C27 turn ON

Key D38: LCDs associated with keys D30 and D37 turn ON
Key D39: LCDs associated with keys D31 and D37 turn ON
Key E48: LCDs associated with keys E40 and E47 turn ON
Key E49: LCDs associated with keys E41 and E47 turn ON

Key F58: LCDs associated with keys F50 and F57 turn ON
Key F59: LCDs associated with keys F51 and F57 turn ON
Key G68: LCDs associated with keys G60 and G67 turn ON

Chart Continued -----

Chart 3-1 Continued
STATION RINGER TEST - KEY SEQUENCES

Key G69: LCDs associated with keys G61 and G67 turn ON.

Note 4: The only messages which are not tested are “Turn On/Off Handsfree Control” and “Open/Close Echo Mode” which are not used by call processing.

Note 5: In this Chart, the term “All LCDs” means LCDs one to eight on the telephone plus all LCDs on any add-on modules connected to the telephone under test.

STEP	KEY OR SWITCH OPERATED (Note 1)	RESPONSE	DIGIT DISPLAY (if equipped) (Note 2)
1	Handset off-hook	All LCDs flash (Note 5)	blank display
2	Handset on-hook	All LCDs fast flash (Note 5)	blank display
3	Handset off-hook	All LCDs are ON (Note 5)	blank display
4	Handset on-hook	All LCDs are OFF (Note 5)	blank display
5	Dial Pad key 1	LCD A1 ON	1
6	Dial Pad key 2	LCD A2 ON	12
7	Dial Pad key 3	LCD A3 ON	123
8	Dial Pad key 4	LCD A4 ON	1234
9	Dial Pad key 5	LCD A5 ON	12345
10	Dial Pad key 6	LCD A6 ON	123456
11	Dial Pad key 7	LCD A7 ON	1234567
12	Dial Pad key 8	LCD A8 ON	12345678
13	Dial Pad key 9	LCDs A1 & A8 ON	123456789
14	Dial Pad key 0	LCDs A2 & A8 ON	1234567890
15	Dial Pad key *	All LCDs are ON (Note 5)	1234567890*
16	Dial Pad key #	All LCDs are OFF	1234567890*#
17	Strip A key 1	LCD A1 ON	1234567890*#
18	Strip A key 2	LCD A2 ON	1234567890*#
19	Strip A key 3	LCD A3 ON	1234567890*#
20	Strip A key 4	LCD A4 ON	1234567890*#
21	Strip A key 5	LCD A5 ON	1234567890*#
22	Strip A key 6	LCD A6 ON	1234567890*#
23	Strip A key 7	LCD A7 ON	1234567890*#
24	Strip A key 8	LCD A8 ON	1234567890*#
25	Strip A key 9	LCDs A1 & A8 ON	1234567890*#
26	Release key (rls)	LCDs A2 & A8 ON	1234567890*#
Read Note 3 before continuing			
27	HLD key	Dial tone sounds from speaker and LCDs A1 to A5 are ON	1234567890*#
28	Vol Up key (UP)	Dial tone volume increases	1234567890*#

Chart Continued -----

Chart 3-1 Continued
STATION RINGER TEST - KEY SEQUENCES

29	Vol Down key (DW)	Dial tone volume decreases	1234567890*#
30	Handset off-hook	Dial tone switches to handset and all LCDs flash	1234567890*#
31	Handset on-hook	Dial tone switches to speaker and all LCDs wink	1234567890*#
32	HLD key	Buzzer sounds for approximately one second, and LCDs A6 to A8 are ON	1234567890*#
33	HD (Hold) key	Alerting tone sounds and all LCDs turn off	1234567890*#
34	Vol Up key (UP)	Alerting tone volume increases	1234567890*#
35	Vol Down key (DW)	Alerting tone volume decreases	1234567890*#
36	HD (Hold) key	Ringling stops and circuit test starts (see Note below)	10/10 (see Note below)

Note: For step 36, when the HOLD key is pressed the alerting tone stops and the display (1234567890*#) is cleared. LCD indicators for keys A2, A3, and A4 will flash for approximately three seconds. This indicates that a circuit test is running. No keys shall be operated during that time as this may cause test failure. When the circuit test is completed, LCD indicators A1 to A8 will turn ON steady and, in most instances, 10/10 will be displayed in the display window (if equipped), as given in Step 36. The numbers in the display, when read from left to right, indicate a count of the messages received against the messages sent. The numbers depend on the office parameter table and may vary between 10 and 50; however, the number to the left of the slash should always be equal in magnitude to the number to the right of the slash. If the indications are as described above, the test has passed. Should one or several add-on units be connected to the set being tested, no indications of any kind will occur on the add-on unit or units during the circuit test. A test failure is indicated when the following occurs:

- (a) the two numbers in the display are not equal
- (b) only the LCD indicators for keys A1, A2, and A8 are ON
- (c) LCD indicators for keys A1, A2, and A8 wink.

Winking LCD indicators for keys A1, A2, and A8 indicate that the test did not run, perhaps due to a timeout in the peripherals (example: high traffic volume). In that case, press the HOLD key again (Step 37) and repeat the station ringer test.

37	HD (Hold) key	All LCDs are cleared (OFF) and test is terminated	Cleared (blank)
----	---------------	---	-----------------

Fig. 3-1
NT4X20-Type Business Set - Key and LCD-Indicator Layout

DISPLAY SCREEN TEST

3.07 If the LCD Screen is to be tested for proper character-input responses (refer to Table 3-A), the “LTS” switch (S3) on the NT4X20AB, AF, AM, and AT business set circuit boards has to be reset. The S3 switch has two toggles. When looking at the circuit board as illustrated in Fig. 2-13, the left hand side toggle (LT0) operates the test function, and the right hand side toggle (LT1) operates the notepad function. Toggles must be set as given in the following text. When the set is to be returned to operating mode, both toggles must be in the OFF position.

Notepad Mode

3.08 In this mode, display screen responses to input can be verified without the need to access switching equipment (“Receive” simulation). The dial pad and volume control keys are switched to “local” mode and are used to enter alpha-numeric data directly into the display. To call up this verification feature, set the notepad toggle (LT1) to ON, while leaving the test toggle (LT0) in the OFF position.

3.09 In Notepad mode, each dial pad key has 4 characters associated with it (Table 3-A). As soon as a dial pad key is depressed, the first character in the sequence for that key will appear at the cursor position (flashing block character). Holding the key down will cause the next character in the sequence to appear after approximately half a second, and so on. This will continue, and the character sequence will repeat, until the key is released. Once a character has been entered on the screen, the cursor automatically advances to the next position. The cursor can also be manipulated by operating the volume control. Volume UP moves the cursor one space back, volume DOWN moves the cursor one space forward. If the volume key remains depressed for a half second, the cursor will progress to the next location and will continue to do so at a rate of 8 characters per second until the key is released. Normal volume control functions are inhibited in the “Notepad” mode.

**Table 3-A
DIAL PAD CHARACTER ENTRIES**

DIAL PAD KEY OPERATED	CHARACTERS IN SEQUENCE OF APPEARANCE
1	1 . ? :
2	2 A B C
3	3 D E F
4	4 G H I
5	5 J K L
6	6 M N O
7	7 P R S

Table Continued -----

Table 3-A Continued
DIAL PAD CHARACTER ENTRIES

DIAL PAD KEY OPERATED	CHARACTERS IN SEQUENCE OF APPEARANCE
8	8 T U V
9	9 W X Y
*	* + - /
0	0 _ Q Z
#	# \$ % @

Note: Entries may be edited by positioning the cursor at the desired location and overstriking the displayed character, using the appropriate dial pad key.

Transmit Mode

3.10 In this mode, a single transmission of the notepad buffer will be forced. Transmission of the notepad buffer begins at the cursor location (display or display image cursor) and continues until the end of the display. Characters will be interpreted in pairs after the cursor position as the hex representation of the message to be transmitted. To transmit message 60H, for example, enter 60 into the notepad positions 30 and 31 and backspace the cursor to position 30. Set the LT0 toggle of the S3 switch to ON. Transmission over the T & R leads begins when LT0 is set, and the LT1 toggle remains in the ON position.

3.11 This verification feature permits a switch simulation when communicating in a closed loop with another DMS-100 Business Telephone.

Semi-Transparent Mode (Receive)

3.12 In this mode, the set will act as a semi-transparent message monitor, i.e. it will display messages sent over the Tip and Ring leads from another set in two-character hex representations. To access this mode, the LT0 toggle must be set to ON, and the LT1 toggle must be set to OFF. This facility may be used to check proper character transmission over the Tip and Ring leads.

4. MAINTENANCE

4.01 Maintenance of the Business Set and the associated add-on units is restricted to replacement of the set, the defective modules, and field replaceable items as required. Refer to Part 5 for ordering information.

5. ORDERING INFORMATION

5.01 Order Business Sets and associated apparatus by quoting part numbers as given in Table 5-A.

5.02 Order field replaceable items for individual sets and/or units by quoting part numbers as given in Table 5-B.

**Table 5-A
ORDERING INFORMATION - BUSINESS SETS AND ADD-ON UNITS**

DESCRIPTION	ORDERING CODE	ENGINEERING CODE
Business Set without Alphanumeric Display, with line cord equipped with Teladapt connectors at both ends and handset cord hardwired to the set.	B0216977	NT4X20AA
Business Set without Alphanumeric Display, with line cord equipped with Teladapt connector at the set end, spade tips at the other end, and handset cord hardwired to the set.	B0217892	NT4X20AE
Business Set without Alphanumeric Display, with line cord and handset cord equipped with Teladapt connectors at both ends.	B0222730	NT4X20AL
Business Set with Alphanumeric Display, with line cord equipped with Teladapt connectors at both ends and handset cord hardwired to the set.	B0216978	NT4X20AB
Business Set with Alphanumeric Display, with line cord equipped with Teladapt connector at the set end, spade tips at the other end, and handset cord hardwired to the set.	B0217893	NT4X20AF
Business Set with Alphanumeric Display, with line cord and handset cord equipped with Teladapt connectors at both ends.	B0222731	NT4X20AM
Business Set with Alphanumeric Display, for Automatic Call Distribution (ACD) service. Equipped with headset jacks at handset side of set. Line cord and handset cord equipped with Teladapt connectors at both ends.	B0223289	NT4X20AT
20-key Add-On Module, A&M only (Note)	(Note)	NT4X20AC
20-key Add-On Module - Extendible	B0220035	NT4X20AG
Auto-Answerback Module Kit (circuit board NT4X21AD and two P0180923 PHM screws .112-40X.250)	B0221388	NT4X20AJ

Table Continued -----

Table 5-A Continued

ORDERING INFORMATION - BUSINESS SETS AND ADD-ON UNITS

DESCRIPTION	ORDERING CODE	ENGINEERING CODE
Handsfree Unit, English (includes HFU power supply)	A0299732	NT1L00AA
Handsfree Unit, bilingual, English/French (includes HFU power supply)	A0320215	NT1L05AA
Add-On Unit Power Supply (Ault)	A0352921	NPS50220-07 List 8

Note: For additions and maintenance (A&M) purposes only.

Table 5-B
ORDERING INFORMATION - FIELD REPLACEABLE ITEMS

DESCRIPTION	ORDERING CODE	ENGINEERING CODE
<i>For NT4X20-Type Business Sets:</i>		
User Guide (English) for NT4X20AA,AE,AL,AT	P0649745	P0649745
User Guide (French) for NT4X20AA,AE,	P0649746	P0649746
User Guide (English) for NT4X20AB,AF,AM,AT	P0660566	P0660566
User Guide (French) for NT4X20AB,AF,	P0660567	P0660567
Agent Telephone Guide for NT4X20AT	P0649655	P0649655
Supervisor Telephone Guide for NT4X20AT	P0649656	P0649656
Line cord 2.1 m (7 ft) long, silver-grey, with Teladapt connector at one end and spade tips at the other end (for NT4A20AE an AF business sets only)	NA800905	KDS-16-4-12
Line cord 2.1 m (7 ft) long, silver-grey, with Teladapt connectors at both ends	A0274382	NE-D6QT-87
Line cord 4.25 m (14 ft) long, silver-grey, with Teladapt connectors at both ends	A0274383	NE-D6QT-87
Line cord Teladapt jack for Business Set base	A0297706	NE-623QN
Handset cord, standard, 2.75 m (9 ft) long, with Teladapt connectors at both ends (for NT4X20AL, AM, and AT Business Sets only)	A0318327	NE-H4DUQA-35
Handset cord, optional, 1.8 m (6 ft) long, with Teladapt connectors at both ends (for NT4X20AL, AM, and AT Business Sets only)	A0274225	NE-H4DUQA-35
Handset cord, optional, 3.7 m (12 ft) long, with Teladapt connectors at both ends (for NT4X20AL, AM, and AT Business Sets only)	A0274243	NE-H4DUQA-35
Hookswitch	B0217888	NT4X2011
Handset, equipped with Teladapt connector but without handset cord (for NT4X20AL, AM, and AT Business Sets only)	A0332374	NTD9558-35
Transmitter unit for Handset	A0288762	QUAG3A
Handset	A0332373	NTD9557-35
Faceplate, black, for NT4X20AA, AE, AL	P0664139	P0664139
Faceplate, black, for NT4X20AB, AF, AM, AT	P0664140	P0664140

Table Continued -----

Table 5-B Continued
ORDERING INFORMATION - FIELD REPLACEABLE ITEMS

DESCRIPTION	ORDERING CODE	ENGINEERING CODE
Faceplate, black, for NT4X20AG (or -AC, rated A&M) Add-on Unit	P0664141	P0664141
Designation Tabs, English	P0586393, and P0596156	P0586393, and P0596156
Designation Tabs, French	P0586394	P0586394
Plastic key cap, clear	P0565036	P0565036
Plastic key cap, red	P0565037	P0565037
Plastic key cap, amber	P0586309	P0586309
Card holder	P0535651	P0535651
<i>For NT1L00AA and NT1L05AA Handsfree Units:</i>		
16 V ac local power supply with T-adapter	A0329941	NPS50220-08 L.4
Yellow, double spade tipped 26 AWG power supply jumper lead, 330 mm (13 in) long	P010E419	P010E419