P/O

244 Distributive Data Bridge System

contents

Note: *This Practice is written with specific reference to 244 Distributive Data Bridge Systems mounted in the Tellabs* **24X Issue 2 Mounting Assembly** *(Tellabs part number* **8224X***) and, except where noted, with specific reference to the following modules:*

- *Issue 4 4451 and 4451A (Tellabs part number 844451[A]).*
- *Issue 1 4452A (Tellabs part number 814452A).*
- *Issue 2 4453 (Tellabs part number 824453).*
- *Issue 5 4454, 4454A, 4455, and 4455A (Tellabs part numbers 854454[A] and 854455[A]).*

If your 244 System contains components of issues other than these and you are not certain whether your Practice documentation is appropriate, please call Tellabs Customer Service at (312) 969-8800 for assistance.

1. general description

1.01 The 244 Distributive Data Bridge (DDB) System (figure 1) is a 4wire-common-port, 4wire-multiple-port active data bridge used in multipoint voice-frequency data networks where simultaneous bidirectional transmission takes place between a central computer and a number of remote data stations. Because it is modular, the 244 System can be arranged in a variety of ways to provide one or more individual bridge networks as desired. The 244 DDB follows a conventional *split* bridge format, i.e., the common port of a bridge network interfaces several multiple ports through separate *splitter* and *combiner* channels. In the splitter channel, the common input is divided a number of ways to provide outputs for the various multiple ports. In the combiner channel, inputs from the multiple ports are connected through the bridge to a common output. Splitter and combiner paths are derived via separate splitter and combiner amplifiers.

1.02 This Practice section is revised to include information on updated versions of several 244-System modules and on two new 244-System modules. The updated modules are the Issue 4 4451 and 4451A modules, the Issue 2 4453 module, and the Issue 5 4454, 4454A, 4455, and 4455A modules. The new modules are the 4452A, a prescription common-port module, and the 4459, an optional test module. This Practice section also contains several minor corrections and revisions.

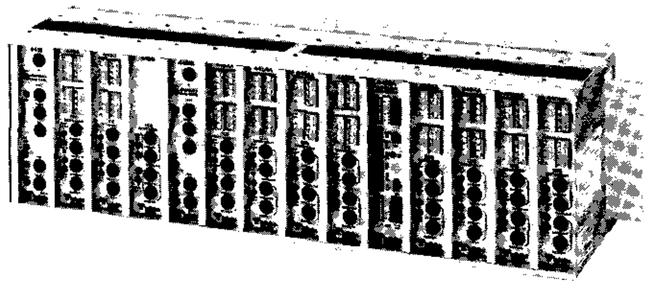


figure 1. 244 DDB System (typical configuration)

1.03 The 244 System comprises nine components: the 4451, 4451A, and 4452A Distributive Data Bridge modules, the 4453, 4454, 4454A, 4455, and 4455A Distributive Data Bridge Termination (DDBT) modules, and the 24X Mounting Assembly (which houses the various types of modules). The 4451, 4451A, or 4452A is the common-port termination device that derives the fully isolated splitter and combiner busses of a 244 Bridge network and provides active level control (amplification) for the network. Each 4453, 4454, 4454A, 4455, or 4455A module terminates one multiple port of a 244 Bridge network and provides passive level control (attenuation) for the multiple port that it terminates. The active circuitry of the 4451, 4451A, and 4452A normally permits a bridge network's multiple ports to be terminated and aligned by passive 445X DDBT modules rather than by more expensive active devices. Within a single 24X Mounting Assembly, the size of a 244 Bridge network can range from 2 to 13 multiple ports, i.e., one 4451, 4451A, or 4452A DDB module can serve from 2 to 13 DDBT modules.

1.04 The 24X Mounting Assembly that houses the various 244-System modules consists of a Tellabs 1012 or 1014 Mounting Shelf equipped with a connectorized printed-circuit backplane. The Assembly is universally prewired to accommodate not only the various 244-System modules but also the modules of Tellabs' 242 (2wire) DDB System and 243 Low-Speed Data Signaling System. (For complete information on these Systems, please consult the 242 and 243 System Practices and related module Practices.) Two versions of the 24X Assembly are available: the 24XA, which houses 12 modules and mounts in a 19-inch relay rack, and the 24XB, which houses 14 modules and mounts in a 23-inch relay rack.

1.05 The 24X Assembly is equipped with five 25-pair female cable connectors for all external connections except battery and ground. Battery and ground connections are made via a barrier-type terminal strip on the Assembly's backplane. Also located on the backplane are several 6-pin wire-wrapping blocks for extending a bridge network from one 24X Assembly to another and a 13-pin terminal used for local or remote test access to the 244 System.

1.06 As stated previously, the 24X Assembly is universally prewired to accommodate three different Tellabs systems. When used with the 244 System, the 24X Assembly may be equipped with as many common-port bridge modules (4451's, 4451A's, and/or 4452A's) and multiple-port bridge modules (445X DDBT's) as required. Module positions are nondedicated (i.e., either a 4451, 4451A, 4452A, or 445X can be used in any position). However, in any bridge network within a 24X Assembly, modules must be arranged in a specific order (see paragraph 2.07). The Assembly's printed-circuit backplane extends the splitter and combiner busses (derived in the 4451, 4451A, or 4452A module) through the bridge network as 445X DDBT modules are added to the Assembly. Option switches on the backplane allow unused module positions between modules in any bridge network in the Assembly to be bypassed without wiring changes.

1.07 A 244 System can be arranged and rearranged for various bridge-network configurations within its overall capacity by adding, removing, or exchanging modules – without wiring changes to the 24X Assembly. For example, the number of multiple ports in an established bridge network may be changed simply by adding or removing 445X DDBT modules as required. When a bridge is changed in this manner, the remaining multiple ports retain their integrity without rewiring or realignment. Levels are maintained within approximately ±1dB, and multiple-port positions from which modules have been removed need not be terminated. As a second example, a System can be converted from one large bridge network (up to 13 multiple ports) in a 24X Assembly to several smaller networks simply by interchanging the appropriate plug-in modules. Wiring changes to implement rearrangement of the bridge are required only at the intermediate distributing frame (IDF) or main distributing frame (MDF) of the serving central office (or at a local cross-connect frame if the 244 System is not installed in a CO). All external connections to the ports of the 244 Bridge itself are made via the cable connectors on the backplane of the 24X Assembly. These cable connections are made only once and need not be changed.

1.08 The remainder of section 1 contains a brief description of each 244-System module. For detailed information on these modules, please refer to their separate Tellabs Practices.

4451 and 4451A Distributive Data Bridge modules

1.09 In a 244 Bridge network, a single 4451 or 4451A DDB module (figure 2) interfaces both channels of the 4wire common-port facility, derives the bridge's splitter (common-port-to-multiple-port) and combiner (multiple-port-to-common-port) busses, contributes active level control and amplitude equalization in both paths, and provides facility-side termination circuitry.

1.10 The splitter and combiner amplifiers of the 4451 and 4451A each provide from −15 to +25dB of gain in four switch-selectable 10dB ranges. Throughout each range, levels are continuously adjustable to within ±0.1dB via front-panel controls. Maximum splitter output level is +5dBm (as measured at the module's *splitter out* jack via 600-ohm terminated measurement); maximum combiner output level is +10dBm. Distortion at maximum output in each channel is less than 1 percent. Actual maximum multiple-port capacity of the 4451 or 4451A module without significant degradation of System transmission characteristics is 26 multiple ports, i.e., 26 DDBT modules. See paragraph 2.06 for details.

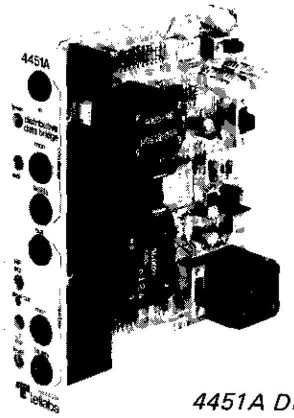


figure 2. 4451A DDB module

1.11 Facility-side impedance-matching transformers in both the splitter and combiner channels can be individually switch-optioned for balanced 600 or 1200-ohm terminating impedance and are center-tapped to derive balanced simplex leads.

1.12 In the splitter channel, any of three modes of amplitude equalization can be selected via switch option to post-equalize the common input to the bridge. These modes are flat (no equalization, equalizer bypassed), high-low equalization for loaded cable or carrier, and slope equalization for nonloaded cable. In the high-low mode, a variety of high-frequency and low-frequency gain shapes can be effected (as is typically required for loaded cable), or flat response with high-end and low-end roll-off can be provided (as is typically required for carrier facilities). In the nonloaded-cable slope equalization mode, frequency response is adjustable from essentially flat to a slope of about 4dB per octave.

1.13 In the combiner channel, slope equalization similar to that available in the splitter channel (i.e., adjustable from essentially flat to a nominal 4dB-per-octave slope) may be introduced to pre-equalize the bridge's output to the common port.

1.14 Both the 4451 and 4451A modules provide a switch-selectable choice of the following: 20mA of balanced sealing current, 20mA of balanced reversal current for manual initiation of dc loopback in appropriate equipment (e.g., a Tellabs 4412-series Data Station Termination module) at the distant end of the common-port facility, or normal simplex-lead derivation. A front-panel light-emitting diode (LED) lights when the sealing-current option is activated and current is flowing.

1.15 An additional switch option on the Issue 4 4451 and 4451A conditions these modules to establish either a low-impedance or high-impedance combiner bus for the bridge networks that they serve. In most applications, the low-impedance option is selected. However, when the Issue 4 4451 or 4451A is used as a replacement for an Issue 1 or Issue 2 4451 or 4451A in an existing bridge network, the high-impedance option provides the same combiner-bus impedance as these earlier modules. The high-impedance option also provides the necessary compatibility when the DDBT modules being used with the Issue 4 4451 or 4451A are any of the following types: Issue 1 4453 and Issue 3 or earlier 4454, 4454A, 4455, and 4455A.

1.16 The 4451 and 4451A modules are identical except for the presence of a bridge-side transfer relay on the 4451A. This relay, when activated, disconnects the common port from the bridge network and connects it to a test bus on the 24X Assembly for local or remote test access. *Testing of the 4451A and its associated 4wire transmission facility is simplified through use of the Tellabs 4459 Loopback/Facility Test Module. This module is designed specifically for use in the 24X (Issue 2) Mounting Assembly. Also, the 4451A's transfer relay is functional only when the 4451A is mounted in a 24X Assembly. The relay will not operate when the 4451A is mounted in a 244 Mounting Assembly. See paragraphs 2.17 through 2.20 for details.*

1.17 Both modules contain an internally regulated power supply that permits operation on −42 to −56Vdc input. Current requirements range from 20mA in the idle state to 60mA in both splitter output and combiner output at maximum levels. For both modules, an additional 21mA is required when the sealing/loopback current option is activated, and, for the 4451A only, an additional 16mA is required when the transfer relay is operated.

1.18 Surge protection is provided for the facility ports of the 4451 and 4451A. Reverse-battery protection and transient-limiting circuitry are provided in the amplifiers' internal power supply circuitry. Resistor-capacitor (RC) filtering and decoupling networks minimize cross-coupling and the effects of noise on the input power leads. Also, module connector pins 8, 14, 44, and 48, which have appearances in the 24X Mounting Assembly's wiring scheme but which are not used with 244-System modules, are internally connected to ground through the Issue 4 4451 and 4451A modules to minimize noise pickup via input/output cabling to the Assembly.

1.19 The front panels of the 4451 and 4451A each contain, in addition to splitter- and combiner-channel level and equalization controls, a complement of six jacks to facilitate alignment and maintenance. Monitoring jacks are provided in both channels on the bridge and facility sides of each module. An opening jack facing the bridge is also provided in each channel at the 4wire common port. Splitter and combiner bus access is provided (via the bridge-side monitoring jacks) by means of resistively isolated ports associated with the bridge splitter and combiner busses.

4452A Distributive Data Bridge module

1.20 As an alternative to the 4451 or 4451A common-port DDB module, the 4452A DDB module (figure 3) can be used in a 244 Bridge network to interface the 4wire common-port facility. Like the 4451 or 4451A, the 4452A derives the network's splitter and combiner busses, contributes bidirectional active level control and amplitude equalization, and provides facility-side termination circuitry. Unlike the 4451 and 4451A, however, the 4452A features full *prescription* alignment.

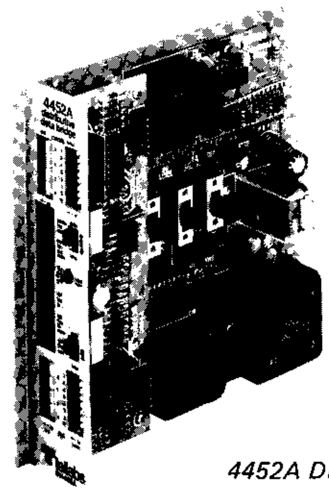


figure 3. 4452A DDB module

1.21 The splitter and combiner amplifiers of the 4452A each provide from −24 to +24dB of gain in discrete 0.1dB increments, as selected via precision front-panel switches. This gain is in addition to a nominal 0.5dB of insertion gain always provided in both channels as "automatic compensation" for the nominal 0.5dB of insertion loss inherent to both channels of the various passive DDBT modules. Maximum splitter-channel output level is +5dBm (as measured at the module's *splitter out* jack via 600-ohm terminated measurement); maximum combiner-channel output level is +10dBm. Distortion in each channel at maximum output is less than 1 percent. Actual maximum multiple-port capacity of the 4452A module without significant degradation of System transmission characteristics is 26 multiple ports, i.e., 26 DDBT modules. See paragraph 2.06 for details.

1.22 Facility-side impedance-matching transformers in both channels of the 4452A can be switch-optioned for balanced 150, 600, or 1200-ohm terminating impedance and are center-tapped to derive balanced simplex leads.

1.23 In either or both channels of the 4452A, up to 7.5dB of active prescription slope equalization at 2804Hz (re 1000Hz) can be introduced in discrete 0.5dB increments via precision front-panel switches. The module's equalizers will yield an additional 2dB of equalized gain on nonloaded cable facilities when the 150-ohm terminating impedance option is selected.

1.24 Like the 4451 and 4451A, the 4452A module provides a switch-selectable choice of 20mA of sealing current, 20mA of reversal current, or normal simplex-lead derivation at the common port. Unlike the other DDB modules, however, the 4452A's sealing-current circuitry includes a "ZAP" feature — a momentarily higher amount of current to eliminate existing oxidation or corrosion on the cable pairs when sealing current is initially applied to the facility. A front-panel LED lights when the sealing-current option is activated and current is flowing.

1.25 An additional switch option on the 4452A conditions the module to establish either a low-impedance or high-impedance combiner bus for the bridge network that it serves. In most applications, the low-impedance option is selected. However, when the 4452A is used as a replacement for an Issue 1 or Issue 2 4451 or 4451A in an existing bridge network, the high-impedance option provides the same combiner-bus impedance as these earlier modules. The high-impedance option also provides the necessary compatibility when the DDBT modules being used with the 4452A are any of the following types: Issue 1 4453 and Issue 3 or earlier 4454, 4454A, 4455, and 4455A.

1.26 Like the 4451A, the 4452A contains a bridge-side transfer relay. This relay, when activated, disconnects the common port from the bridge network and connects it to a test bus on the 24X Assembly for local or remote test access. *Testing of the 4452A and its associated 4wire transmission facility is simplified through use of the Tellabs 4459 Loopback/Facility Test Module. This module is designed specifically for use in the 24X (Issue 2) Mounting Assembly. Also, the 4452A's transfer relay is functional only when the 4452A is mounted in a 24X Assembly. The relay will not operate when the 4452A is mounted in a 244 Mounting Assembly. See paragraphs 2.17 through 2.20 for details.*

1.27 The 4452A contains an internally regulated power supply that permits operation on −42 to −56Vdc input. Current requirements range from 20mA in the idle state to 60mA with both splitter output and combiner output at maximum levels. An additional 22mA is required when the sealing/loopback current option is activated, and an additional 16mA is required when the transfer relay is operated.

1.28 Surge protection is provided for the facility ports of the 4452A. Reverse-battery protection and transient-limiting circuitry are provided in its amplifiers' internal power supply circuitry. Resistor-capacitor (RC) filtering and decoupling networks minimize cross-coupling and the effects of noise on the input power leads. Also, module connector pins 8, 14, 44, and 48, which have appearances in the 24X Mounting Assembly's wiring scheme but which are not used with 244-System modules, are internally connected to ground through the 4452A module to minimize noise pickup via input/output cabling to the Assembly.

1.29 The front panel of the 4452A contains, in addition to splitter- and combiner-channel level and equalization switches, a complement of six jacks to facilitate alignment and maintenance. These jacks are identical to those of the 4451 and 4451A (see paragraph 1.19) except that they are bantam-type instead of the larger 310-type.

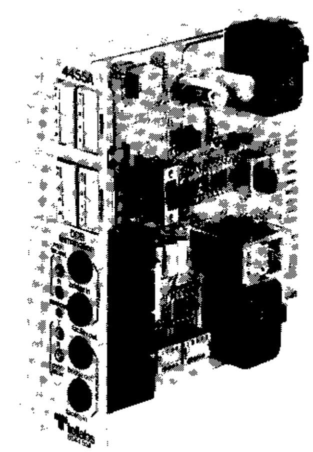


figure 4. 4455A DDB Termination module

4454, 4454A, 4455, and 4455A DDBT modules

1.30 The 4454, 4454A, 4455, and 4455A Distributive Data Bridge Termination (DDBT) modules (figure 4) each terminate and establish levels passively at one multiple port of a 244 Bridge network. The 4454, which is the simplest DDBT module of the four, provides balanced, switch-selectable 150, 600, or 1200-ohm terminating impedance on the facility side, thus allowing the 4454 to interface various types of transmission facilities (typically, short and intermediate loops of nonloaded cable and short loops of loaded cable). The 4454's impedance-matching transformers are center-tapped to derive simplex leads toward the multiple port. Level control is achieved via precision attenuation switches on the module's front panel and printed circuit board. From 0 to 32.5dB of loss (not including 0.5dB of insertion loss always present) may be independently introduced into the splitter (multiple-port output) channel and the combiner (multiple-port input) channel in discrete 0.1dB increments.

1.31 The 4455 is identical to the 4454 in all respects except one: the 4455 provides high-frequency and low-frequency post-equalization in the combiner channel; the 4454 does not. The 4455's high-frequency equalizer introduces up to 4dB of "bump" equalization at 3400Hz, and the low-frequency equalizer provides gradually adjustable low-end roll-off (6dB per octave, 8dB maximum) beginning at about 1500Hz. Combiner-channel frequency response is flat when no equalization is selected. The 4455 is typically used to interface short and intermediate loops of loaded or nonloaded cable.

1.32 The 4454A and 4455A are identical to the 4454 and 4455, respectively, except for the inclusion of a transfer relay on the bridge side of each module. This relay, when activated, disconnects the multiple port from the bridge network and connects it to a test bus for local or remote test access. *Testing of the 4454A and 4455A and their associated 4wire transmission facilities is simplified through use of the Tellabs 4459 Loopback/Facility Test Module. This module is designed specifically for use in the 24X (Issue 2) Mounting Assembly. Also, the transfer relay on the 4454A and 4455A is functional only when these modules are mounted in a 24X Assembly. The relay will not operate when the 4454A and 4455A are mounted in a 244 Mounting Assembly. See paragraphs 2.17 through 2.20 for details.*

1.33 The 4454, 4454A, 4455, and 4455A modules each provide a switch-selectable choice of the following: 20mA of balanced sealing current, 20mA of balanced reversal current for manual initiation of dc loopback in appropriate equipment (e.g., a Tellabs 4412-series Data Station Termination module) at the distant end of the multiple-port facility, or normal simplex lead derivation. A front-panel LED lights when the sealing-current option is activated and current is flowing.

1.34 An additional switch option on the Issue 5 4454, 4454A, 4455, and 4455A conditions each module to operate in a bridge network with either a low-impedance or high-impedance combiner bus. In most applications, the low-impedance option is selected. However, when the Issue 5 4454, 4454A, 4455, or 4455A is used as an addition or a replacement in bridge networks where the associated common-port DDB module is an Issue 1 or Issue 2 4451 or 4451A, an Issue 4 4451 or 4451A switch-optioned to establish a high-impedance combiner bus, or a 4452A of any issue switch-optioned to establish a high-impedance combiner bus, the 4453's high-impedance option provides the necessary compatibility for operation with these common-port modules.

1.35 Four strap options on the Issue 5 4454, 4454A, 4455, and 4455A provide for a more efficient module arrangement when a 244 Bridge network is expanded through the addition of DDBT modules in a *second* 24X Assembly. See paragraph 2.14 for details.

1.36 In addition to individual splitter and combiner attenuation switches, the front panels of the 4454, 4454A, 4455, and 4455A each contain a complement of four jacks and four test points to facilitate alignment and maintenance. One bridge access jack and one facility access jack (both of which are opening jacks facing the module) plus one pair of facility monitor test points are provided in each channel.

1.37 The 4454, 4454A, 4455, and 4455A each operate on −42 to −56Vdc filtered, ground-referenced input. Current requirements for the 4454 and 4455 are 5mA without the sealing current or loopback option activated and 26mA with either of these options activated. Current requirements for the 4454A and 4455A are the same as those of the 4454 and 4455 plus an extra 16mA for operation of the transfer relay (42mA maximum). As is true of the Issue 4 4451 and 4451A modules and the 4452A module, connector pins 8, 14, 44, and 48 of the Issue 5 4454, 4454A, 4455, and 4455A modules are internally connected to ground through the modules to minimize noise pickup.

4453 DDBT module

1.38 Like the 4454, 4454A, 4455, and 4455A DDBT modules, the 4453 DDBT module terminates and establishes levels passively at one multiple port of a 244 Bridge network. The 4453, however, differs from the other DDBT modules in that it is designed specifically to interface one multiple port of a 244 Bridge network with a carrier channel. On its multiple-port facility side, the 4453 provides transformer coupling with fixed, balanced 600-ohm terminating impedance. Amplitude equalization and simplex leads, however, are **not** available. Fixed attenuator pads introduce 23dB of loss into both the splitter (multiple-port output) and combiner (multiple-port input) channels independently. Because insertion loss in each channel is approximately 0.5dB, total attenuation in each channel with the pads inserted is 23.5dB. These pads can, if desired, be switch-optioned out of either or both channels to provide a nominal 0.5dB of loss.

1.39 In typical applications (see figure 5), a signal received from a carrier channel at a +7 transmission level point (TLP) must be attenuated by 23.5dB to provide a −16.5TLP on the 244 System's combiner bus, while a signal at a +7.5 on the System's splitter bus must also be attenuated by 23.5dB to provide a −16TLP into the carrier transmit channel. In those infrequent applications where the carrier TLP's are the reverse of normal, i.e., +7 for transmit (instead of −16) and −16 for receive (instead of +7), the 4453's attenuators are optioned out of the circuit to accommodate this situation. Please be aware that the nominal 0.5dB of insertion loss in each channel of the 4453 necessitates the 244 System's splitter and combiner bus levels being a nominal 0.5dB higher and lower, respectively, than the "standard" +7 splitter and −16 combiner TLP's that would be used if the 4453 had zero insertion loss. (Please refer to section 3 of this Practice for information on how bus levels are determined and set in the 244 System.)

Note: *The 4452A common-port DDB module "compensates" for the nominal 0.5dB insertion loss of the 4453 module (as well as for that of the 4454, 4454A, 4455, and 4455A DDBT modules) by adding an additional 0.5dB of gain to that indicated by the 4452A's prescription level-control switches. See the 4452A Practice for details.*

1.40 The 4453's front panel contains the same complement of bridge and facility access jacks and facility monitor test points as the 4454, 4454A,

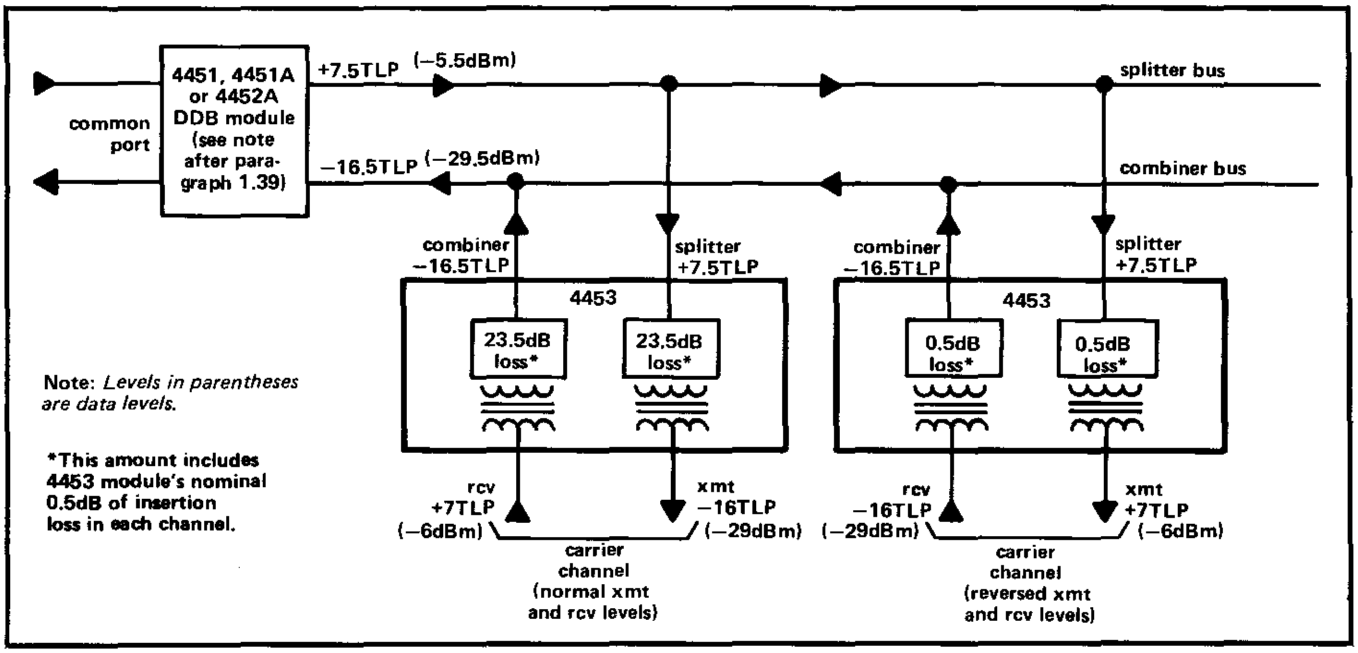


figure 5. Typical applications of 4453 DDBT module

4455, and 4455A modules. Also like these other DDBT modules, the Issue 2 4453 has an option switch that conditions it for use in bridge networks with either low-impedance or high-impedance combiner busses. It also has the same four strap options that provide for more efficient module arrangement when expanding a 244 Bridge network to a second 24X Assembly (see paragraph 2.14). In addition, module connector pins 8, 14, 44, and 48 of the Issue 2 4453 are internally connected to ground through the module to minimize noise pickup, just as they are on the other DDBT modules.

2. application

2.01 The 244 Distributive Data Bridge (DDB) System interfaces a common 4wire port with multiple 4wire ports to provide a bridge network normally used for the transmission of voice-frequency data signals. As such, the 244 DDB System may be used at a central office or at a remote location to provide a bridging network between, for example, a number of outstation data modems and a centralized computer. This arrangement is commonly found in credit card verification systems and in branch banking operations.

2.02 To perform its data bridging function, the 244 DDB System uses a *split* bridge design, i.e., the common port is interfaced with the multiple ports through separate *splitter* and *combiner* channels. In the splitter channel, input received from the common facility is split a number of ways to be transmitted out at all multiple ports. In the combiner channel, an input signal received from any multiple port is connected through the bridge and transmitted out of the common port.

2.03 As stated above, splitter and combiner channels are separate. The two independent channels accommodate data transmission in the full-duplex mode (i.e., simultaneous bidirectional transmission) that is characteristic of most 244-System applications.

2.04 Physically, the 244 DDB System may be located in a central office or on the customer's premises. The 24X Mounting Assembly that houses the 244 System is available in two versions, both designed for relay-rack installation. The 24XA Assembly houses up to twelve 244-System modules and mounts in a 19-inch rack, while the 24XB Assembly houses up to fourteen 244-System modules and mounts in a 23-inch rack. Both versions are universally wired and connectorized.

2.05 Eight modules are used in various combinations to accommodate most 244-System applications. They are the active 4451, 4451A, and 4452A DDB modules and the passive 4453, 4454, 4454A, 4455, and 4455A DDBT modules. Each is described briefly in section 1 of this Practice.

Note: *The 4451A, 4452A, 4454A, and 4455A modules contain a local/remote-test-access transfer relay that is enabled only when these modules are mounted in a Tellabs 24X Assembly. When mounted in a 244 Assembly, the 4451A, 4454A, and 4455A function exactly like the 4451, 4454, and 4455, respectively. The 4452A has no counterpart without a transfer relay. See paragraph 2.16 for details.*

system capacity

2.06 Within a single 24XA (12-position) Mounting Assembly, the size of a 244 Bridge network (as served by one 4451, 4451A, or 4452A DDB module) can range from 2 to 11 multiple ports (as provided by 2 to 11 DDBT modules). Within a single 24XB (14-position) Mounting Assembly, the size of a 244 Bridge network can range from 2 to 13 multiple ports. If more than one 24X Assembly is available, however, one 4451, 4451A, or 4452A module can serve up to 26 multiple ports, i.e., 26

DDBT modules, with no significant degradation of System transmission performance. If even larger bridge networks are required, tandem bridge arrangements can be used to greatly expand the number of multiple ports. See paragraphs 2.12 through 2.14 for information on expanding a 244 Bridge network to a second 24X Assembly. See paragraph 2.15 for information on tandem bridge arrangements.

module arrangement

2.07 As stated earlier, module positions in the 24X Assembly are nondedicated: any of the various 244-System modules may be plugged into any slot in the Assembly, so long as modules within a bridge network are in appropriate positions relative to each other. A 4451, 4451A, or 4452A DDB module defines the beginning of a bridge network. The associated 445X DDBT modules are plugged into subsequent slots beginning at the immediate right of the 4451, 4451A, or 4452A, as viewed from the front of the Assembly (see figure 6). Within the 24X Assembly, up to 13 DDBT modules, either of a single type or mixed as necessary, can be used in association with the 4451, 4451A, or 4452A DDB module. Should you arrive at the Assembly's rightmost module position while assigning 445X DDBT modules, additional DDBT modules can still be added to that bridge network in any of several ways, as described in paragraphs 2.11 through 2.14.

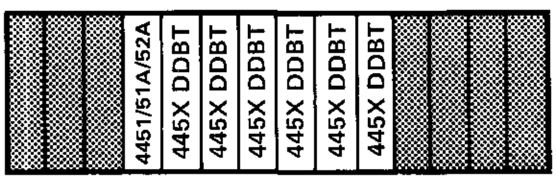


figure 6. Front view of 244 Assembly showing left-to-right module arrangement of bridge network

splitter and combiner busses and Assembly bypass switches

2.08 Splitter and combiner busses are extended through a 244 Bridge network by both the associated modules and the printed circuit backplane of the 24X Assembly. Paragraphs 2.09 and 2.10 explain where and how a 244 Bridge network continues from module to module and from module position to module position. These paragraphs also explain where and how a 244 Bridge network starts and stops (i.e., is not continued between modules).

2.09 The 4451, 4451A, or 4452A DDB module interrupts the splitter and combiner busses at the point where the module is inserted into the 24X Assembly. On the other hand, the 445X DDBT modules extend the busses to adjacent lefthand and righthand module positions. Interruption of the busses by the 4451, 4451A, and 4452A is necessary because each of these modules defines the beginning of a bridge network (that is, it breaks the circuit with the module position to its immediate left).

2.10 Bypass switches are located at the rear of each module position in the 24X Assembly (see figure 7). They may be used to extend a bridge network through a vacant module position occurring between modules in a network. The 24X Assembly's bypass switches have two settings: *BYPASS* and *OFF*. The switch at a module position housing a 4451, 4451A, or 4452A DDB module is normally set to *OFF* so that the circuit is broken to the immediate left of the 4451, 4451A, or 4452A. This allows the 4451, 4451A, or 4452A to perform its function of establishing the splitter and combiner busses for the single bridge network that it serves. Bypass switches at module positions occupied by DDBT modules may be set to either *BYPASS* or *OFF*, with no direct effect on that particular bridge network at that particular time. However, Tellabs recommends that the switches of module positions occupied by DDBT modules be set to *BYPASS* to provide circuit continuity in the event that a DDBT module is later removed from the Assembly (leaving that module position vacant) when circuit requirements change. And, of course, if vacant module positions are originally designed into an individual network in the 24X Assembly, bypass switches are used to extend splitter and combiner busses across those vacant module positions. *(If we've managed to confuse you with the above explanation, see figure 8 for a visual example.)*

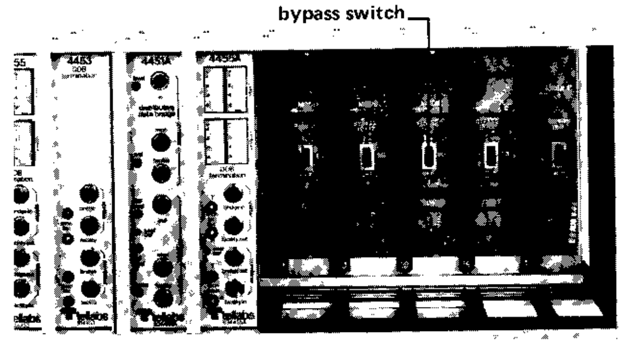
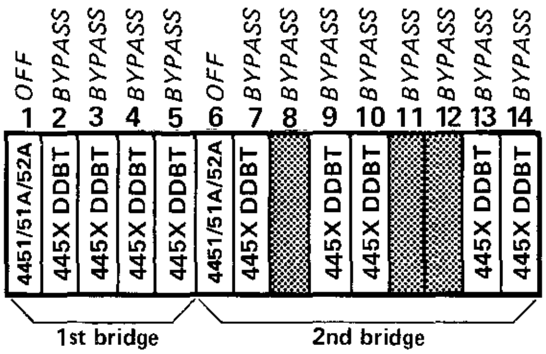


figure 7. Front view of 24X Assembly

expansion of existing bridge networks

2.11 If, while assigning 445X DDBT modules to a 244 Bridge network, you arrive at the last available module position at the righthand end of the Assembly, additional 445X modules may still be added to that bridge network in several ways, as long as the maximum number of 445X's per bridge network is not exceeded. For example, if one or more module positions beginning with position 1 at the lefthand end of the Assembly are available, 445X modules may simply be inserted into these positions as shown in figure 9a. This is because the splitter and combiner busses "wrap around" from the last module position to the first module position due to the design of the Assembly's printed circuit backplane. Other hypothetical expansion arrangements with **two 244 Bridge networks mounted in the same Assembly** are shown in figures 9b through 9e. Please note that, in figures 9b through 9e, some module positions must be left empty to avoid interconnecting the two bridge networks. Also, for certain module positions, the required Assembly bypass switch settings (*OFF* or *BYPASS*) are shown. These are exceptions to the general bypass-switch rules in paragraph 2.10 and are necessary, in the expansion arrangements shown, to either extend or break splitter and combiner bus continuity between critical module positions. (Note, for example, that setting the bypass switch at a position housing a 4451/51A/52A to *BYPASS* instead of to the normal *OFF* position extends the splitter and combiner busses to the left as well as to the right of the 4451/51A/52A. This allows expansion of a bridge network to the immediate left as well as to the right of the 4451/51A/52A.) For those module positions where Assembly bypass switch settings are not shown, the bypass switches are set to their normal positions as described in paragraph 2.10 and also in paragraph 3.08.



Note: *Switches at all positions housing 4451/51A/52A DDB modules must be set to* OFF. *Switches at positions 8, 11, and 12 are set to* BYPASS *to extend splitter and combiner busses through these vacant positions, thus interconnecting all modules of the second bridge network. (Service provided by modules once occupying positions 8, 11, and 12 has been discontinued and the modules have been removed to be used elsewhere, but the remaining ports of the second bridge retain their integrity.) Switches at all positions housing DDBT modules may be set to* OFF *or* BYPASS, *but* BYPASS *is recommended to maintain continuity in the event that a module is later removed from service.*

figure 8. Use of bypass switches on a 24XB Assembly in a hypothetical arrangement of two individual bridge networks

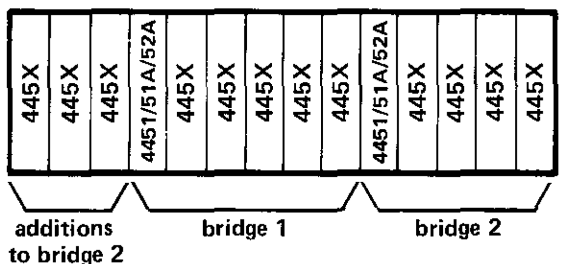


figure 9a.

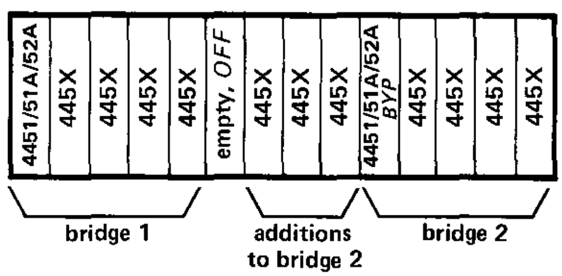


figure 9b.

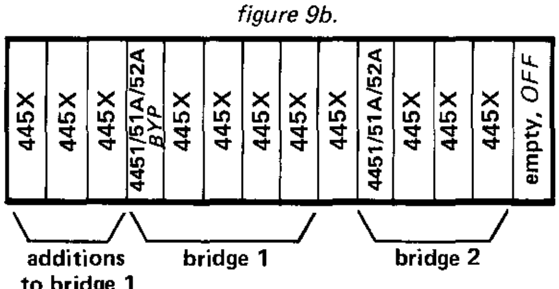


figure 9c.

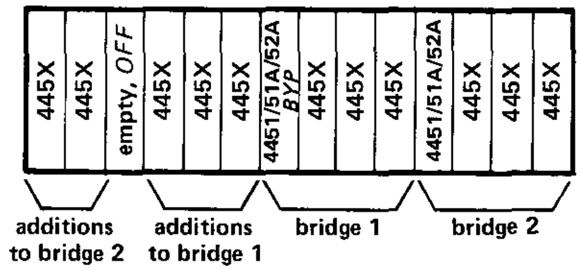


figure 9d.

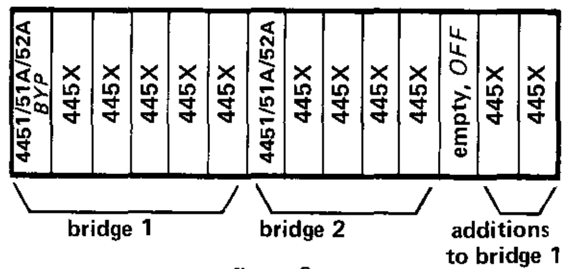


figure 9e.

figure 9. Hypothetical expansion arrangements with two bridge networks mounted in same Assembly

2.12 In applications where **more than two Bridge networks are installed in the same Assembly** and one or more of these networks are to be expanded to vacant module positions in the same Assembly, jumper wiring may be required between specific six-pin wire-wrapping blocks on the Assembly's backplane (see figure 10). Also, in applications where **a 244 Bridge network in one Assembly is to be expanded to vacant module positions in a second Assembly,** jumper wiring is **always** required between one or more six-pin blocks on the first Assembly and one or more six-pin blocks on the second Assembly. These pin blocks are provided specifically to facilitate bridge-network expansion by extending (via jumpers) the splitter and combiner busses of a bridge network to vacant module positions in the same or in a different Assembly. On the 24XA (12-position) Assembly, 6-pin blocks are located behind

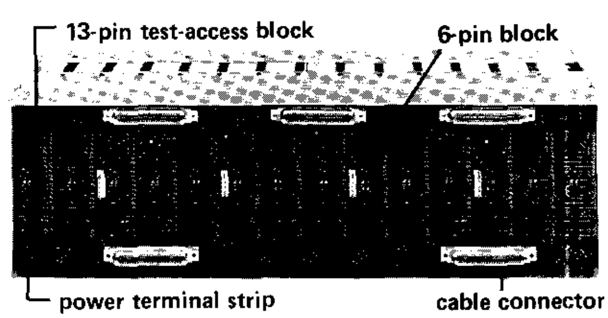


figure 10. Rear view of 24X Assembly

module positions 3, 6, and 9. On the 24XB (14-position) Assembly, 6-pin blocks are located behind module positions 3, 6, 9, and 12. As a general rule, a group of 445X DDBT modules can be installed either to the left or to the right of the module position at which the jumpers are connected. In all cases, however, the following three guidelines hold true:

A. The six-pin block behind a particular module position accesses the bridge-side ports of a 4451/51A/52A DDB module or 445X DDBT module when the module is located in that position. (For the 4451/51A/52A, these are the combiner bus input and splitter bus output ports, respectively; for the 445X, these are the combiner bus output and splitter bus input ports.)

B. If (1) the module position behind which a six-pin block is located is empty and (2) the bypass switch for that position is set to *BYPASS*, the six-pin block accesses the bridge-side ports of a 4451/51A/52A or 445X module located in the *preceding* module position. If the preceding module position is also empty and its bypass switch is set to *BYPASS*, the six-pin block accesses the splitter and combiner bus appearances at the preceding module position.

C. If (1) the module position behind which a six-pin block is located is empty, (2) the bypass switch for that position is set to *OFF*, and (3) a 445X module is located in the *following* module position, the six-pin block accesses the bridge-side ports of that 445X module. If a 4451/51A/52A module is located in the following module position, access to its bridge-side ports is provided only if the bypass switch for its module position is set to *BYPASS*.

2.13 For expanding 244 Bridge networks via jumpering (on the same Assembly or between two Assemblies), four jumpers (splitter tip, splitter ring, combiner tip, and combiner ring) are required. This means that only four of the six available pins on the Assembly's wire-wrapping blocks need be used. Paragraph 3.12 provides details on installing these jumpers. Figures 11a through 11g show hypothetical expansion arrangements with more than two

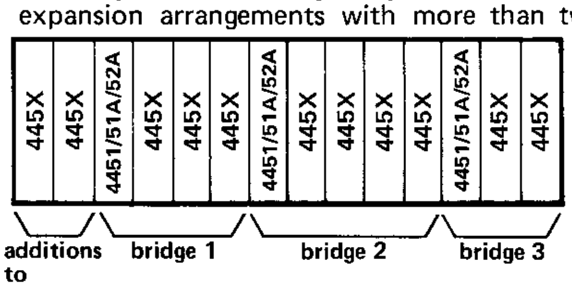


figure 11a.

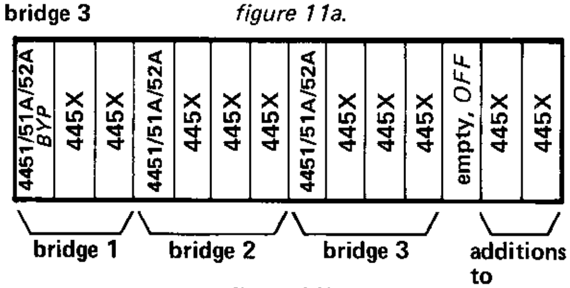


figure 11b.

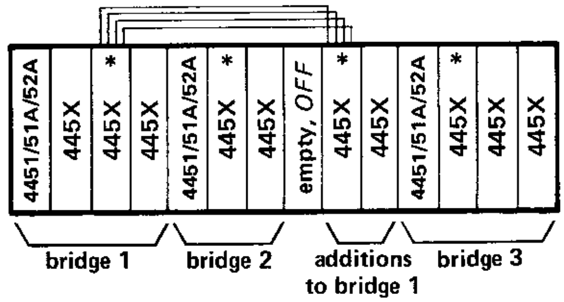


figure 11c.

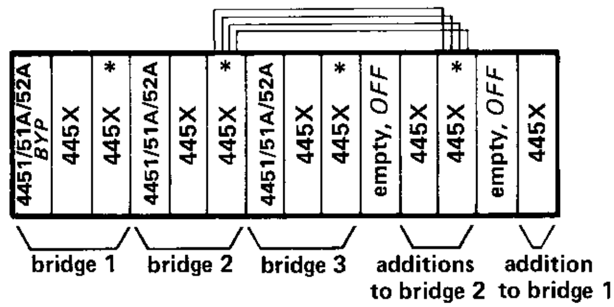


figure 11d.

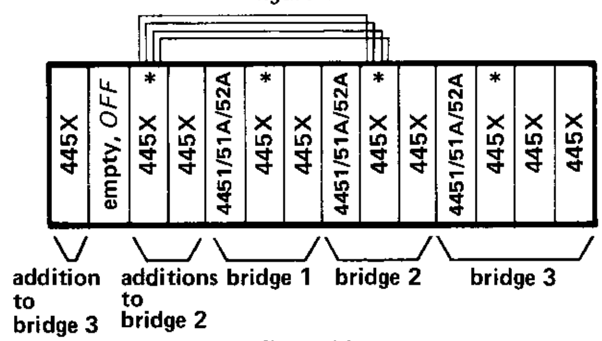


figure 11e.

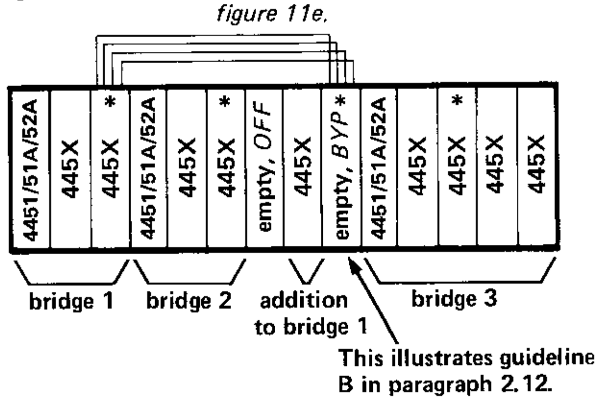


figure 11f.

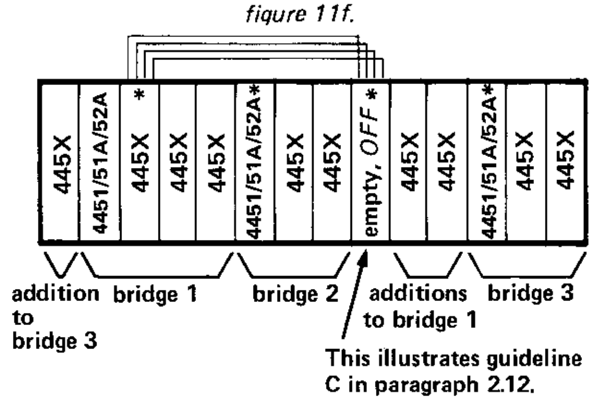


figure 11g.

figure 11. Hypothetical expansion arrangements with more than two bridge networks in same Assembly

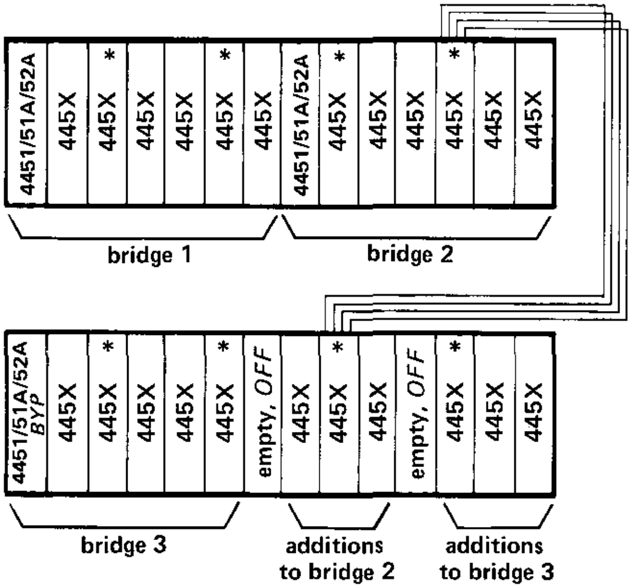


figure 12a.

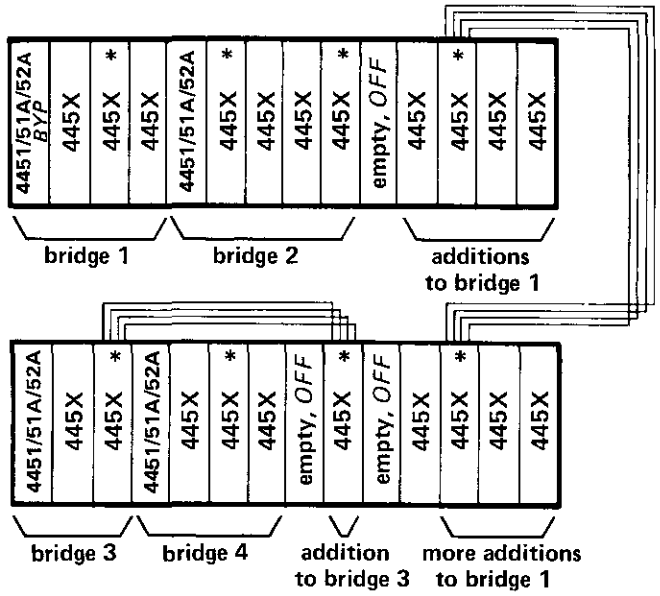


figure 12b.

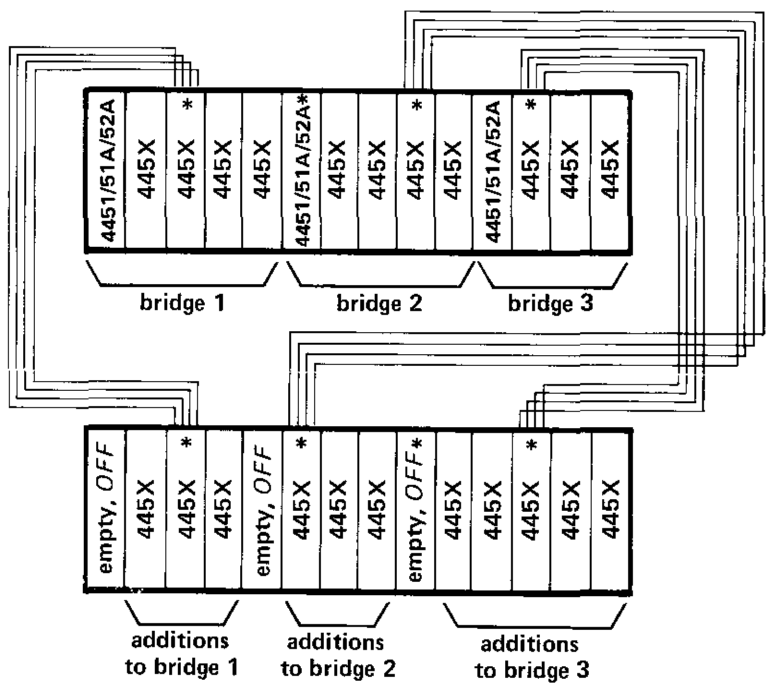


figure 12c.

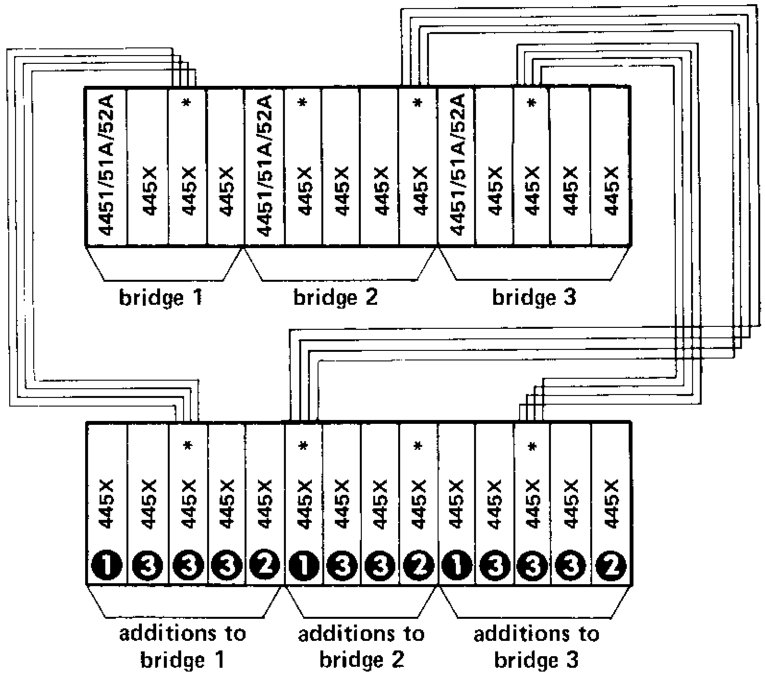
figure 12. Hypothetical bridge network expansion arrangements from one Assembly to another

bridge networks mounted in the same Assembly. Figures 12a through 12c show hypothetical bridge-network expansion arrangements from one Assembly to another. In the diagrams where jumper wiring is shown, asterisks (*) indicate module positions behind which six-pin blocks are located. Also, as in figure 9, exceptions to the normal bypass switch settings are shown where appropriate.

Note 1: *In applications where* **two** *bridge networks are mounted in the same Assembly and the recommended module arrangement is observed (i.e., 445X's to the immediate right of their associated 4451/51A/52A's), jumper wiring should never be necessary for expanding the bridge networks to empty module positions in the same Assembly.*

Note 2: *For jumpering between two Assemblies in applications where length of the jumpers will exceed 15 feet, Tellabs recommends that shielded connecting cable be used and that the cable shield be grounded at one end only.*

Special Note: *The Issue 2 4453 DDBT module and the Issue 5 4454, 4454A, 4455, and 4455A DDBT modules each contain four strap options that provide for greater efficiency of module arrangement when expanding a 244 Bridge network to a second 24X Assembly. Details follow in paragraph 2.14.* **If your DDBT modules are the above types and issues, be certain to read paragraph 2.14 before proceeding with jumper installation.**



❶ Cut or remove straps on these, the leftmost 445X DDBT modules of their groups, and set the assembly bypass switches at their module positions to **OFF**.

❷ Cut or remove straps on these, the rightmost 445X DDBT modules of their groups, and set the assembly bypass switches at their module positions to **BYPASS**.

❸ Straps need not be cut on these DDBT modules. If they are cut, the assembly bypass switches at their positions must be set to **BYPASS**.

*Denotes locations of wire-wrapping terminal blocks on assembly backplanes.

figure 13. Expansion of existing bridge networks through additional DDBT modules in second 24X Assembly

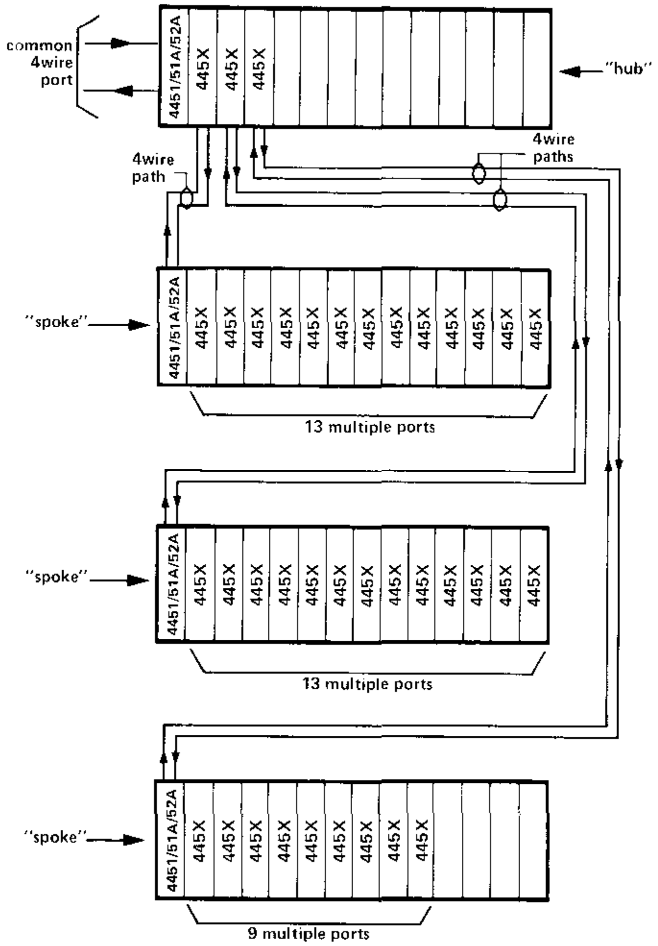
2.14 Strap options *ST1* through *ST4* on the printed circuit board of the Issue 2 4453 module and strap options *ST6* through *ST9* on the printed circuit boards of the Issue 5 4454, 4454A, 4455, and 4455A modules provide increased efficiency of module arrangement when expanding a 244 Bridge network from one mounting assembly to another via jumpering between the wire-wrapping terminal blocks on the assemblies' backplanes. With previous issues of these DDBT modules, module positions to the left or right of the DDBT module or modules being added in a second assembly had to be left empty to prevent automatic connection of these modules to other bridge networks or bridge-network additions in the same assembly. By cutting or removing the straps on the current issues of these DDBT modules, however, the splitter and combiner busses are opened within the module so that continuity of both busses to adjacent module positions in the assembly is controlled solely by the bypass switch at the rear of the module's mounting-assembly position (as viewed from the front of the assembly). Thus, groups of DDBT modules equipped with these straps can be installed immediately adjacent to one another in the same assembly without unwanted interconnection of their independent bridge networks. To do this, the straps are cut or removed on the leftmost and rightmost modules of each group, and the assembly bypass switches at these modules' positions are set appropriately: to *OFF* for the leftmost module of the group or when the bridge-network addition is a single DDBT module, and to *BYPASS* for the rightmost module of the group. Figure 13 shows how this is done for a hypothetical arrangement involving additions in a second assembly to three existing bridge networks. Locations of the straps on the various modules are shown in the Tellabs Practices on those modules.

Note: *If a DDBT module whose straps have been cut or removed is to be used in any module position other than the rightmost or leftmost in its group (i.e., in a middle position), its assembly bypass switch* **must** *be set to the* **BYPASS** *position to provide splitter and combiner bus continuity to the adjacent modules.*

tandem operation

2.15 For large bridge-network applications requiring more than 13 multiple 4wire ports (or more than 26 multiple 4wire ports if two 24X Mounting Assemblies are being used), 244 Systems can be arranged in tandem, i.e., a multiple port of one 244 System can be wired to the common port of another 244 System. The number of multiple ports that can be established in a bridge network in this manner is greatly increased. For example, if a maximally configured single-Assembly 244 Bridge is wired to each multiple port of another maximally configured single-Assembly 244 Bridge, the number of multiple ports is increased from 13 to 169. A tandem arrangement of this type is shown in figure 14.

Note 1: *This tandem arrangement, as well as others where the common port of one bridge network serves as the common port of the entire tandem arrangement while the common ports of all other bridge networks in the tandem arrangement interface the multiple ports of the first, is sometimes called a "hubbing" arrangement. The bridge network serving as the entire tandem arrangement's common port is the "hub," and the other bridge networks that provide the tandem arrangement's multiple ports are the "spokes."*



Note: *This arrangement, as shown, provides 35 multiple ports. Theoretical maximum is 169, as provided by thirteen 445X's in hub and thirteen maximally configured single-Assembly (i.e., thirteen 445X's each) spokes (13 x 13 = 169).*

figure 14. 244 tandem bridging arrangement

Note 2: *If some or all of the spokes in a tandem arrangement are at different locations than the hub, 4wire voice-frequency transmission facilities are required between the various locations, and appropriate interconnections between the bridge networks' 24X Mounting Assemblies and the 4wire facilities must be made. Transmission levels between the hub and spokes of any tandem arrangement will depend upon the individual circuit requirements of the particular application.*

Caution 1: *When more than two 244 Bridge networks are tandemed in series (i.e., where at least one spoke connected to the hub has additional spokes of its own), transmission parameters may be degraded somewhat from those specified in this Practice. If a series tandem arrangement of more than two 244 Bridge networks is desired for a particular application, be certain that the resultant performance will be acceptable for that application. Consult Tellabs' Application Engineering Group at (312) 969-8800 or your Tellabs Regional Office if you need additional information on tandem bridge applications.*

Caution 2: *In any tandem bridge arrangement, the splitter bus level of every bridge network in the arrangement should be the same. This is also true for the combiner bus level of every bridge network in the arrangement. Otherwise, excessive noise may result.*

levels and alignment

2.16 All gain in a 244 Bridge is provided by the 4451, 4451A, or 4452A DDB module. The 4451, 4451A, or 4452A provides the same amount of gain for all paths in a given channel. Splitter and combiner gain levels are, of course, individually adjustable. Levels for individual multiple ports are established via attenuators on the 445X DDBT modules. In basic theory, gain is introduced into both channels by the 4451, 4451A, or 4452A module to coordinate bus levels with common-port facility levels, and loss is introduced via the DDBT modules' attenuators to coordinate bus levels with multiple-port facility levels. Once a 244 Bridge is aligned, multiple ports may subsequently be added or deleted without significantly affecting levels at any of the established ports. For the overall 244-System alignment procedure, refer to paragraphs 3.16 through 3.19 of this Practice. For specific information on level and equalization adjustment for each of the modules in the 244 System, refer to their individual Tellabs Practices.

common-port and multiple-port module and facility testing

2.17 As mentioned previously, the 4451A, 4452A, 4454A, and 4455A modules each contain a transfer relay that can be activated either locally or remotely to disconnect the common port (4451A or 4452A) or a multiple port (4454A or 4455A) from the bridge network and connect it to a test-access bus (24X Assembly only) for local or remote testing of the common-port or multiple-port module and facility. Connections for remote testing are made via 25-pair cable connector *P5* on the 24X Assembly. Connections for local testing are made via 13-pin terminal block *TL1* located behind the 24X Assembly's rightmost module position (i.e., position 12 of the 24XA or position 14 of the 24XB). For local testing only, a connectorized control/test cable must be connected between connector *P5* and terminal block *TL1*; see paragraphs 2.18 through 2.20 for additional information.

2.18 Testing of 244-System modules and their associated 4wire transmission facilities can be performed quickly and easily through use of the Tellabs **4459 DDB Loopback/Facility Test Module** (figure 15). This module is designed specifically for use in the 24X (Issue 2) Mounting Assembly and with those 244-System modules that contain transfer relays (see paragraph 2.17). Testing via the 4459 can be performed either at the location where the 244 System is installed or from a remote location, e.g., a centralized test site.

2.19 If testing of 244-System modules is to take place from the location where the System is installed,

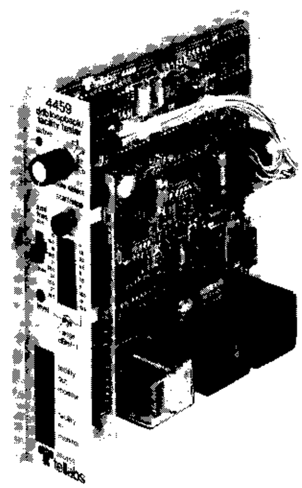


figure 15. 4459 DDB Loopback/Facility Test Module

the 4459 module is installed in the rightmost module position (as viewed from the front) of the 24X Assembly that houses the 244 System. For local testing, the connectorized control/test cable (Tellabs part number 50-4006) supplied with the 4459 module must be connected between 25-pair female cable connector *P5* and 13-pin test connector *TL1* on the backplane of the 24X Assembly. **Note:** *The 24X-Assembly bypass switch setting at the module position housing the 4459 is immaterial, i.e., the switch can be set to either* BYPASS *or* OFF *without affecting operation of the 4459.*

2.20 If testing of 244-System modules is to take place from a remote location, the 4459 module is installed in a conventional Tellabs Type 10 Mounting Shelf at that location. One end of the control/test cable is connected to 25-pair cable connector *P5* of the 24X Issue 2 Assembly that houses the 244 System to be tested. The other end of the control/test cable, instead of being connected to 13-pin connector *TL1* of the 24X Assembly, is connected (via additional cabling) to the appropriate pins of the 56-pin connector at the rear of the module position of the Type 10 Shelf in which the 4459 is installed. For details and complete instructions for 244-System testing via the 4459 module, please refer to the separate Tellabs Practice on the 4459 (Practice section 8X4459).

3. installation

inspection

3.01 The 244 DDB System and its component modules should be inspected upon arrival in order to find possible damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the equipment should be inspected again prior to installation.

mounting

3.02 The 24XA (12-position) Mounting Assembly mounts in a standard 19-inch relay rack, while the 24XB (14-position) Assembly mounts in a standard 23-inch relay rack. Each version of the 24X Assembly occupies 6 inches of vertical rack space.

installer connections

3.03 All external connections to the 24X Assembly except battery and ground are made via the five 25-pair female cable connectors (*P1* through *P5*) on the Assembly's backplane. The 24X Issue 2 Assembly is truly universal in that the same Assembly can simultaneously house a 244 (4wire) DDB System, a 242 (2wire) DDB System, and a 243 Low-Speed Data Signaling System. Table 1 lists the specific connectors that are used when the 242, 243, and 244 Systems (and combinations thereof) are installed in a single 24X Assembly.

3.04 As indicated in table 1, connectors *P2* and *P4* are used in all 244-System applications. These connectors accommodate the input and output connections to the System. Connector *P5* is used (in 244-System applications) solely for common-port and multiple-port local or remote test access.

25-pair cable connector 24X (Issue 2) Assembly backplane					Tellabs Systems that can be accommodated through use of indicated cable connectors
P1	P2	P3	P4	P5	
	X		X		1) 244 Bridge networks only, without capability of remote/local testing via 4459 Loopback/Facility Test Module
	X		X	X	1) 244 Bridge networks only, with remote/local test capability via 4459 module 2) 242 Bridge networks only (for which this is the most economical cabling arrangement) 3) Independent 242 and 244 Bridge networks in same Assembly, without remote/local test capability for 244 networks via 4459 module 4) Tandem bridge arrangements with 242- and 244-System modules intermixed within bridge networks
X	X	X	X		1) 243 Systems only 2) Independent 242 networks, 244 networks, and/or 243 Systems in same Assembly, without remote/local test access for 244 networks via 4459 module 3) Independent tandem bridge arrangements and 243 Systems in same Assembly 4) Tandem bridge arrangements as described above (for which this is a less economical cabling arrangement than that of preceding table entry) 5) 242 Bridge networks only (for which this is a less economical cabling arrangement than that of preceding table entry) 6) 244 Bridge networks only, without remote/local test capability via 4459 module unless special wiring is done at MDF to access 4459 via connectors P1 and P3 (See System wiring diagram in 244 Practice). (Again, this arrangement is less economical than those of first and second table entries.)
X	X	X	X	X	1) Same as items 1 through 6 in preceding table entry, but with remote/local test access via 4459 module for any 244 networks in Assembly

table 1. 24X Issue 2 Assembly backplane connector usage

Connectors *P1* and *P3* are not used in applications involving 244 Systems only. Tables 2 and 3 list, for cable connectors *P2* and *P4*, respectively, all module-connector and cable-connector pin numbers and all lead colors for every 24X-Assembly module position. Table 4 provides similar information for connector *P5*. Make all connections at the distributing frame (or at the local cross-connect frame if the 244 System is installed at a customer location) as directed in these tables. The System Wiring Diagram, section 4 of this Practice, may also be helpful during the wiring procedure. For reference, table 5 correlates the 13 pins of local-test-access terminal *TL1* with their respective module-connector pinouts at the rightmost module positions of the 24XA and 24XB Assemblies, and tables 6a and 6b

244-System modules — connector P2

24XA/ 24XB (Issue 2) module position	56-pin module connector pin no.	25-pair cable connector pin no.	lead color	connector P2 lead designations for each module when used in listed module positions: 4451/4451A/4452A DDB module	4453/4454/4454A/4455/4455A DDB Termination module
1	43	1	BL-W	comb out SX	facility out SX
	9	26	W-BL	split in SX	facility in SX
	13	2	O-W	split in R	facility in R
	7	27	W-O	split in T	facility in T
	47	3	G-W	comb out R	facility out R
	41	28	W-G	comb out T	facility out T
2	43	4	BR-W	comb out SX	facility out SX
	9	29	W-BR	split in SX	facility in SX
	13	5	S-W	split in R	facility in R
	7	30	W-S	split in T	facility in T
	47	6	BL-R	comb out R	facility out R
	41	31	R-BL	comb out T	facility out T
3	43	7	O-R	comb out SX	facility out SX
	9	32	R-O	split in SX	facility in SX
	13	8	G-R	split in R	facility in R
	7	33	R-G	split in T	facility in T
	47	9	BR-R	comb out R	facility out R
	41	34	R-BR	comb out T	facility out T
4	43	10	S-R	comb out SX	facility out SX
	9	35	R-S	split in SX	facility in SX
	13	11	BL-BK	split in R	faicility in R
	7	36	BK-BL	split in T	facility in T
	47	12	O-BK	comb out R	facility out R
	41	37	BK-O	comb out T	facility out T
5	43	13	G-BK	comb out SX	facility out SX
	9	38	BK-G	split in SX	facility in SX
	13	14	BR-BK	split in R	facility in R
	7	39	BK-BR	split in T	facility in T
	47	15	S-BK	comb out R	facility out R
	41	40	BK-S	comb out T	facility out T
6	43	16	BL-Y	comb out SX	facility out SX
	9	41	Y-BL	split in SX	facility in SX
	13	17	O-Y	split in R	facility in R
	7	42	Y-O	split in T	facility in T
	47	18	G-Y	comb out R	facility out R
	41	43	Y-G	comb out T	facility out T
7	43	19	BR-Y	comb out SX	facility out SX
	9	44	Y-BR	split in SX	facility in SX
	13	20	S-Y	split in R	facility in R
	7	45	Y-S	split in T	facility in T
	47	21	BL-V	comb out R	facility out R
	41	46	V-BL	comb out T	facility out T

table 2. Cable connector P2 lead assignments for 244-System modules in 24X Issue 2 Assembly

244-System modules — connector P4

24XA/ 24XB (Issue 2) module position	56-pin module connector pin no.	25-pair cable connector pin no.	lead color	connector P4 lead designations for each module when used in listed module positions: 4451/4451A/4452A DDB module	4453/4454/4454A/4455/4455A DDB Termination module
8	43	50	V-S	comb out SX	facility out SX
	9	25	S-V	split in SX	facility in SX
	13	49	V-BR	split in R	facility in R
	7	24	BR-V	split in T	facility in T
	47	48	V-G	comb out R	facility out R
	41	23	G-V	comb out T	facility out T
9	43	47	V-O	comb out SX	facility out SX
	9	22	O-V	split in SX	facility in SX
	13	46	V-BL	split in R	facility in R
	7	21	BL-V	split in T	facility in T
	47	45	Y-S	comb out R	facility out R
	41	20	S-Y	comb out T	facility out T
10	43	44	Y-BR	comb out SX	facility out SX
	9	19	BR-Y	split in SX	facility in SX
	13	43	Y-G	split in R	facility in R
	7	18	G-Y	split in T	facility in T
	47	42	Y-O	comb out R	facility out R
	41	17	O-Y	comb out T	facility out T
11	43	41	Y-BL	comb out SX	facility out SX
	9	16	BL-Y	split in SX	facility in SX
	13	40	BK-S	split in R	facility in R
	7	15	S-BK	split in T	facility in T
	47	39	BK-BR	comb out R	facility out R
	41	14	BR-BK	comb out T	facility out T
12	43	38	BK-G	comb out SX	facility out SX
	9	13	G-BK	split in SX	facility in SX
	13	37	BK-O	split in R	facility in R
	7	12	O-BK	split in T	facility in T
	47	36	BK-BL	comb out R	facility out R
	41	11	BL-BK	comb out T	facility out T
13*	43	35	R-S	comb out SX	facility out SX
	9	10	S-R	split in SX	faciity in SX
	13	34	R-BR	split in R	facility in R
	7	9	BR-R	split in T	facility in T
	47	33	R-G	comb out R	facility out R
	41	8	G-R	comb out T	facility out T
14*	43	32	R-O	comb out SX	facility out SX
	9	7	O-R	split in SX	facility in SX
	13	31	R-BL	split in R	facility in R
	7	6	BL-R	split in T	facility in T
	47	30	W-S	comb out R	facility out R
	41	5	S-W	comb out T	facility out T

*24XB (14-position) Assembly only.

table 3. Cable connector P4 lead assignments for 244-System modules in 24X Issue 2 Assembly

244-System modules — connector P5

24XA/ 24XB (Issue 2) module position	56-pin module connector pin no.	25-pair cable connector pin no.	lead color	connector P5 lead designations for each module when used in listed module pos.: 4454A/4455A DDB Termination module with transfer relay and 4451A/4452A DDB common module w/transfer relay
1	49	50	V-S	—
	45	25	S-V	transfer relay control
2	49	49	V-BR	—
	45	24	BR-V	transfer relay control
3	49	48	V-G	—
	45	23	G-V	transfer relay control
4	49	47	V-O	—
	45	22	O-V	transfer relay control
5	49	46	V-BL	—
	45	21	BL-V	transfer relay control
6	49	45	Y-S	—
	45	20	S-Y	transfer relay control
7	49	44	Y-BR	—
	45	19	BR-Y	transfer relay control
8	49	43	Y-G	—
	45	18	G-Y	transfer relay control
9	49	42	Y-O	—
	45	17	O-Y	transfer relay control
10	49	41	Y-BL	—
	45	16	BL-Y	transfer relay control
11	49	40	BK-S	—
	45	15	S-BK	transfer relay control
12	49	39	BK-BR	—
	45	15	BR-BK	transfer relay control
13*	49	38	BK-G	—
	45	13	G-BK	transfer relay control
14*	49	37	BK-O	—
	45	12	O-BK	transfer relay control
1 through 7	42	30	W-S	facility out test access T
	50	5	S-W	facility out test access R
	5	29	W-BR	facility in test access T
	12	4	BR-W	facility in test access R
	37	33	R-G	—
	39	8	G-R	—
8 through 14*	42	27	W-O	facility out test access T
	50	2	O-W	facility out test access R
	5	26	W-BL	facility in test access T
	12	1	BL-W	facility in test access R
	37	32	R-O	—
	39	7	O-R	—

*Module positions 13 and 14 on 24XB Assembly only.

table 4. Cable connector P5 remote-test-access lead assignments for 244-System modules in 24X Issue 2 Assembly

test-access terminal block TL1 pin no.	24XA Assembly module position 12 pin no.	24XB Assembly module position 14 pin no.
1	18	18
2	20	20
3	22	22
4	24	24
5	26	26
6	28	28
7	30	30
8	32	32
9	34	34
10	36	36
11	38	38
12	40	40
13	46	46

table 5. Correlation of test-access terminal block TL1 pin numbers to module-connector pin numbers of rightmost module positions of 24XA and 24XB Assemblies

24X-Assembly input/output connector assignments

24X Issue 2 Assembly module position	connector P1 56-pin module conn. pin	connector P1 25-pair cable conn. pin	connector P1 lead color	connector P2 56-pin module conn. pin	connector P2 25-pair cable conn. pin	connector P2 lead color	connector P5 56-pin module conn. pin	connector P5 25-pair cable conn. pin	connector P5 lead color
1	49	1	BL-W	43	1	BL-W	49	50	V-S
	45	26	W-BL	9	26	W-BL	45	25	S-V
	14	2	O-W	13	2	O-W	–	–	–
	8	27	W-O	7	27	W-O	–	–	–
	48	3	G-W	47	3	G-W	–	–	–
	44	28	W-G	41	28	W-G	–	–	–
2	49	4	BR-W	43	4	BR-W	49	49	V-BR
	45	29	W-BR	9	29	W-BR	45	24	BR-V
	14	5	S-W	13	5	S-W	–	–	–
	8	30	W-S	7	30	W-S	–	–	
	48	6	BL-R	47	6	BL-R	–	–	–
	44	31	R-BL	41	31	R-BL	–	–	–
3	49	7	O-R	43	7	O-R	49	48	V-G
	45	32	R-O	9	32	R-O	45	23	G-V
	14	8	G-R	13	8	G-R	–	–	–
	8	33	R-G	7	33	R-G		–	–
	48	9	BR-R	47	9	BR-R	–		–
	44	34	R-BR	41	34	R-BR	–	–	–
4	49	10	S-R	43	10	S-R	49	47	V-O
	45	35	R-S	9	35	R-S	45	22	O-V
	14	11	BL-BK	13	11	BL-BK		–	–
	8	36	BK-BL	7	36	BK-BL	–	–	–
	48	12	O-BK	47	12	O-BK	–	–	–
	44	37	BK-O	41	37	BK-O	–	–	–
5	49	13	G-BK	43	13	G-BK	49	46	V-BL
	45	38	BK-G	9	38	BK-G	45	21	BL-V
	14	14	BR-BK	13	14	BR-BK	–	–	–
	8	39	BK-BR	7	39	BK-BR	–	–	–
	48	15	S-BK	47	15	S-BK	–	–	–
	44	40	BK-S	41	40	BK-S	–	–	–
6	49	16	BL-Y	43	16	BL-Y	49	45	Y-S
	45	41	Y-BL	9	41	Y-BL	45	20	S-Y
	14	17	O-Y	13	17	O-Y	–	–	–
	8	42	Y-O	7	42	Y-O	–	–	–
	48	18	G-Y	47	18	G-Y	–	–	–
	44	43	Y-G	41	43	Y-G	–	–	–
7	49	19	BR-Y	43	19	BR-Y	49	44	Y-BR
	45	44	Y-BR	9	44	Y-BR	45	19	BR-Y
	14	20	S-Y	13	20	S-Y	–	–	–
	8	45	Y-S	7	45	Y-S	–	–	–
	48	21	BL-V	47	21	BL-V	–	–	–
	44	46	V-BL	41	46	V-BL	–	–	–
1 through 7	42	24	BR-V	–	–	–	42	30	W-S
	50	49	V-BR	–	–	–	50	5	S-W
	5	25	S-V	–	–	–	5	29	W-BR
	12	50	V-S	–	–	–	12	4	BR-W
	37	23	G-V	–	–	–	37	33	R-G
	39	48	V-G	–	–	–	39	8	G-R

Note: There are no connector-P3 or connector-P4 assignments for module positions 1 through 7.

table 6a. Input/output connector assignments for 24X Assembly, module positions 1 through 7

24X Issue 2 Assembly module position	connector P3 56-pin module conn. pin	connector P3 25-pair cable conn. pin	connector P3 lead color	connector P4 56-pin module conn. pin	connector P4 25-pair cable conn. pin	connector P4 lead color	connector P5 56-pin module conn. pin	connector P5 25-pair cable conn. pin	connector P5 lead color
8	49	50	V-S	43	50	V-S	49	43	Y-G
	45	25	S-V	9	25	S-V	45	18	G-Y
	14	49	V-BR	13	49	V-BR	–	–	–
	8	24	BR-V	7	24	BR-V	–	–	–
	48	48	V-G	47	48	V-G	–	–	–
	44	23	G-V	41	23	G-V	–	–	–
9	49	47	V-O	43	47	V-O	49	42	Y-O
	45	22	O-V	9	22	O-V	45	17	O-Y
	14	46	V-BL	13	46	V-BL	–	–	–
	8	21	BL-V	7	21	BL-V	–	–	–
	48	45	Y-S	47	45	Y-S	–	–	–
	44	20	S-Y	41	20	S-Y	–	–	–
10	49	44	Y-BR	43	44	Y-BR	49	41	Y-BL
	45	19	BR-Y	9	19	BR-Y	45	16	BL-Y
	14	43	Y-G	13	43	Y-G	–	–	–
	8	18	G-Y	7	18	G-Y	–	–	–
	48	42	Y-O	47	42	Y-O	–	–	–
	44	17	O-Y	41	17	O-Y	–	–	–
11	49	41	Y-BL	43	41	Y-BL	49	40	BK-S
	45	16	BL-Y	9	16	BL-Y	45	15	S-BK
	14	40	BK-S	13	40	BK-S	–	–	–
	8	15	S-BK	7	15	S-BK	–	–	–
	48	39	BK-BR	47	39	BK-BR	–	–	–
	44	14	BR-BK	41	14	BR-BK	–		–
12	49	38	BK-G	43	38	BK-G	49	39	BK-BR
	45	13	G-BK	9	13	G-BK	45	14	BR-BK
	14	37	BK-O	13	37	BK-O	–		
	8	12	O-BK	7	12	O-BK	–	–	–
	48	36	BK-BL	47	36	BK-BL	–	–	–
	44	11	BL-BK	41	11	BL-BK	–	–	–
13*	49	35	R-S	43	35	R-S	49	38	BK-G
	45	10	S-R	9	10	S-R	45	13	G-BK
	14	34	R-BR	13	34	R-BR	–	–	–
	8	9	BR-R	7	9	BR-R		–	–
	48	33	R-G	47	33	R-G	–	–	–
	44	8	G-R	41	8	G-R	–	–	–
14	49	32	R-O	43	32	R-O	49	37	BK-O
	45	7	O-R	9	7	O-R	45	12	O-BK
	14	31	R-BL	13	31	R-BL		–	–
	8	6	BL-R	7	6	BL-R	–		–
	48	30	W-S	47	30	W-S	–		
	44	5	S-W	41	5	S-W	–	–	
8 through 14*	42	27	W-O	–	–	–	42	27	W-O
	50	2	O-W	–	–	–	50	2	O-W
	5	26	W-BL	–	–	–	5	26	W-BL
	12	1	BL-W	–	–	–	12	1	BL-V
	37	28	W-G	–	–		37	32	R-O
	39	3	G-W	–	–	–	39	7	O-R

Note: There are no connector P1 or connector-P2 assignments for module positions 8 through 14.
*Module positions 13 and 14 on 24XB Assembly only.

table 6b. Input/output connector assignments for 24X Assembly, module positions 8 through 14

list all pin numbers and lead colors for connectors *P1* through *P5* on the 24X Assembly.

3.05 Now connect all external leads (except power and ground) by plugging the 25-pair connectorized cables into their receptacles on the rear of the 24X Assembly. The reversible connector hold-down brackets on the 24X Assembly's backplane are designed for use with both high-profile and low-profile 25-pair cable connector hoods. Figure 16 shows how the reversible brackets are attached to the standoff posts with both kinds of hoods. In addition, the 24X Issue 2 Assembly's cable connectors also accommodate the newer self-locking plastic cable-connector housings that do not require hold-down brackets.

Note: *If 244-System modules are to be mounted in a Type 10 Shelf that is not prewired, Bridge interconnections and external connections must be made to the Shelf's module connectors. Refer to the Tellabs Practice on each module for pin assignments.*

3.06 After all cables are in place, make the required power connections to the 244 System via the two-position barrier-type terminal strip located at the lower lefthand corner of the 24X Assembly's backplane (as viewed from the rear of the Assembly). Connect −42 to −56Vdc filtered battery to

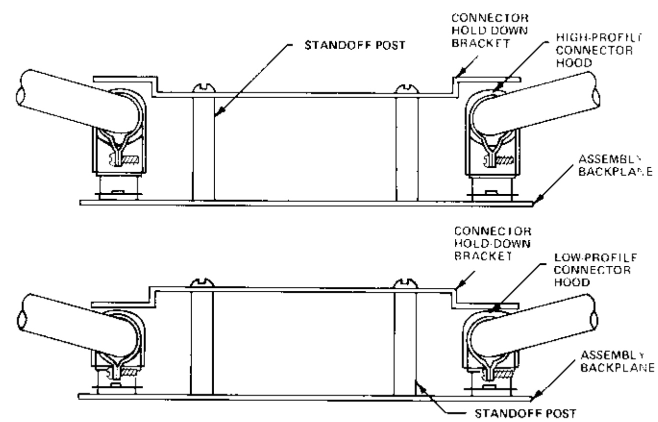


figure 16. Attachment of reversible hold-down brackets when used with high-profile cable connector hoods (upper illustration) and with low-profile hoods (lower illustration)

the negative (−) terminal and ground to the positive (+) terminal of the terminal strip.

module placement and bypass switches

3.07 Before plugging modules into a wired and powered 24X Assembly, bypass switches on the Assembly must be set. Module bypass switches (one per module position) are located on the 24X Assembly's printed circuit backplane and are accessible from the **front** of the Assembly when the modules are removed (see figure 7).

3.08 When 244-System modules are to be installed in a 24X Assembly, set the bypass switch for each module position as follows:

· to *BYPASS* when a 4453, 4454, 4454A, 4455, or 4455A DDBT module is placed in that position;
· to *BYPASS* if it is desired to continue the bridge network through an empty module position;
· to *OFF* if it is desired **not** to continue a bridge network through an empty module position.

Note: *When you are expanding bridge networks to vacant module positions in the same or in a different Assembly, exceptions to these rules may sometimes be necessary. See paragraphs 2.11 through 2.14 for details.*

3.09 Before inserting the appropriate complement of modules, ensure that each module is properly optioned for its intended application. All options are selected via slide switches or DIP switches located on the printed circuit board of each module. Refer to the appropriate module Practices for specific optioning information.

3.10 After all options are selected and external connections, power, and ground are verified, insert the modules into the 24X Assembly. Modules must be inserted in their proper slots, as determined by cabling assignment at the distributing frame. The installer should have specific information regarding which module to insert into which slot. (Bridge network engineering and the assignment of module slots are discussed in paragraphs 2.07 through 2.10.) Unless expansion of existing bridge networks is required (see paragraphs 3.11 through 3.14), proceed to **alignment**, paragraph 3.15.

expansion of established bridge networks

3.11 If the number of multiple ports of an established 244 Bridge network in a 24X Assembly must be increased and not enough room is available for the required number of 445X DDBT modules to the right of that bridge network (either because the last module position in the Assembly has been reached or because another bridge network is occupying the module positions to the immediate right of that bridge network), the bridge network can still be expanded in any of three ways, depending upon the total number of multiple ports required. If 13 or fewer multiple ports (i.e., 13 or fewer DDBT modules) are required and if vacant module positions are available elsewhere in the same Assembly (i.e., separated by one or more other bridge networks from the bridge network to be expanded), the bridge network can often be expanded to the vacant positions without the need for rearrangement of existing modules. Depending upon the arrangement of the existing modules, jumpering between two six-pin wire-wrapping blocks on the Assembly's backplane to extend the bridge network's splitter and combiner busses to the vacant module positions may or may not be required, as described in paragraphs 2.11 through 2.14. If 26 or fewer multiple ports are required and no additional room is available in the Assembly, the bridge network can be expanded to a second 24X Assembly via jumpering between a six-pin block on the first Assembly and another six-pin block on the second Assembly. If more than 26 multiple ports (the maximum for one 244 Bridge network) are required, tandem expansion involving additional bridge networks will be necessary. Paragraphs 3.12 through 3.14 contain instructions for expansion via these three methods.

expansion to vacant module positions in the same or in a second Assembly

3.12 If an existing 244 Bridge network is to be expanded to vacant module positions in the same Assembly, determine whether jumper wiring between six-pin wire-wrapping blocks is required (see paragraphs 2.11 through 2.14). If it is not, simply insert the required 445X DDBT modules in the designated empty module positions (reference to figures 8 and 10 may be helpful in this procedure). If jumper wiring between two six-pin blocks on the same Assembly is required, or if a 244 Bridge network is to be expanded to a second Assembly (in which case jumper wiring is required between a six-pin block on the first Assembly and a six-pin block on the second), make the connections between the six-pin blocks as follows (reference to paragraphs 2.12 through 2.14 and to figures 11 through 13 will definitely be helpful in this procedure):

A. Determine the six-pin wire-wrapping block that will be used for jumper connections at the **existing** bridge network. This will normally be the **first** block to the **left** of the 4451/51A/52A DDB module of the bridge network to be expanded, as viewed from the **rear** of the Assembly.

B. Determine the six-pin wire-wrapping block that will be used for jumper connections to the **additional** 445X DDBT module(s) that will be located elsewhere in the same Assembly, or in a second Assembly. This is normally done as follows: Leave at least one empty module position to the **right** (as viewed from the **front**) of any existing bridge network (or bridge network extension) adjacent to the vacant module positions to be used. Set that module position's bypass switch to *OFF* to prevent unwanted interconnection of bridge networks. The six-pin block to be used will be the **first** block to the **left** of the empty module position, as viewed from the **rear** of the Assembly.

C. Wire the **four lowest pins** of the two blocks together as follows: bottommost pin to bottommost pin, second pin from bottom to second pin from bottom, etc. These four pins are, bottom to top, splitter tip, splitter ring, combiner tip, and combiner ring. The two uppermost pins, which are not used in this procedure, are spares reserved for future System enhancements.

Note: *For jumpering between two Assemblies in applications where jumper length will exceed 15 feet, use shielded cable and ground the cable shield at one end only.*

D. Insert the required 445X DDBT modules in the designated module positions (those to the right of the empty position left in step B). Note that these positions can be both to the right and to the left of the position at which the jumper connections are made. Ensure that a DDBT module is placed in the position to which the jumper connections have been made, or that bypass switches of empty positions between the connection point and the first module are set to *BYPASS*. No additional common-port 4451/51A/52A DDB modules are required in the second Assembly when a bridge network is expanded by this method.

E. If a new bridge network is to be located to the right of the bridge network extension just installed, the new network's common-port 4451/51A/52A DDB module may be installed in the module positions to the immediate right of the last 445X DDBT module of the extension (with the 4451/51A/52A position's bypass switch set to *OFF*).

F. If an extension of another bridge network is to be located to the right of the bridge network extension just installed, the module position to the immediate right of the last DDBT module of the first extension must be left vacant and that position's bypass switch set to *OFF*.

expansion via tandem arrangements

3.13 If a 244 Bridge network is to be arranged in tandem with one or more additional 244 networks to form a large network with more than 13 multiple 4wire ports (or more than 26 multiple 4wire ports if two Assemblies are being used), interconnections between bridge networks are made at the distributing or cross-connect frame rather than between six-pin wire-wrapping blocks on the Assemblies themselves. (For simplicity, we are assuming here that each bridge network is to be installed in its own 24X Assembly and that all Assemblies are located on the same premises.) Specifically, these interconnections are made via leads of the Assemblies' 25-pair cables rather than via direct jumpering between the 6-pin blocks on the Assemblies' backplanes.

3.14 The method by which a 244 Bridge network can be expanded through tandem arrangement is covered in paragraphs 2.15. If you are not already familiar with the engineering of tandem bridge arrangements, contact Tellabs' Customer Service Group at (312) 969-8800 or your Tellabs Regional Office for advice, consultation, and application drawings.

alignment

3.15 Gain in both channels of a 244 Bridge network is provided by the 4451/51A/52A DDB common-port module. Each of the two amplifiers (splitter and combiner) on the 4451/51A/52A provides the same amount of gain for all paths in its respective channel. Levels at the multiple ports are set individually via attenuators on the 445X DDBT modules. Basically, gain provided by the 4451/51A/52A module coordinates bridge-network bus levels with common-port facility levels, and loss provided by the DDBT modules coordinates bridge-network bus levels with multiple-port facility levels. This is explained more thoroughly in paragraphs 3.16 through 3.19, which contain step-by-step instructions for aligning a 244 Bridge network by two different methods: a "basic" method and a method for establishing predetermined bus levels. Specific information on adjusting level and equalization controls on the individual 244-System modules is provided in the separate Tellabs Practices on these modules.

Note 1: *The alignment procedures that follow are based upon the following assumptions: (1) alignment is being performed locally, (2) all pre-alignment optioning (e.g., impedance matching) is completed, (3) equalization at the common and multiple ports is either completed as directed in the individual module Practices or not required, and (4) the 445X DDBT modules referred to in the procedures are 4454's, 4454A's, 4455's, and/or 4455A's. If your bridge network contains 4453's (note that one is shown in figure 19), refer to the separate Tellabs Practice on the 4453 for level-adjustment information.*

Note 2: *Either channel of a 244 Bridge network may be aligned first. In the alignment procedures that follow, the splitter channel will be aligned first and the combiner channel second.*

Note 3: *The 4451/51A/52A's* splitter out *jack cannot be used to send tones to the 445X DDBT modules, nor can its* combiner in *jack be used to measure combiner bus levels from the DDBT modules.*

Note 4: *Please be aware that the 4452A common-port DDB module "compensates" for the nominal 0.5dB insertion loss of the 4453, 4454, 4454A, 4455, and 4455A DDBT modules by adding an additional 0.5dB of gain to that indicated by the 4452A's prescription level-control switches. See the 4452A Practice for details.*

basic alignment procedure

3.16 In the basic alignment procedure (when aligning the splitter channel first), the multiple port with the lowest input level from the remote data station (i.e., with the greatest amount of facility loss) is determined, and the splitter attenuator switches on the 445X DDBT module serving this worst-case multiple port are set for zero loss. Next, the splitter amplifier on the 4451/51A/52A DDB module is adjusted to provide the proper output level toward the data station at the worst-case multiple port. All other 445X DDBT modules' splitter attenuator switches are then set to provide the various output levels required at the remaining multiple ports. In combiner-channel alignment, the combiner attenuator switches on the 445X DDBT module serving the worst-case multiple port are set for zero loss. (Thus, the worst-case multiple-port input level automatically becomes the combiner bus level.) Next, the combiner amplifier on the 4451/51A/52A DDB module is set to provide the proper common-port output level toward the central computer or processor. Finally, the combiner attenuator switches on all 445X DDBT modules except that serving the worst-case multiple port are set to attenuate their multiple-port input levels to the same level: that of the worst-case multiple port.

Note: *A slight variation of the basic alignment method can be advantageous in applications where future bridge-network expansion is expected. In this variation, the bridge network is aligned to accommodate the greatest* **anticipated** *(rather than* **actual***) multiple-port facility loss. This eliminates the need for bridge network realignment if a multiple port with an input level lower than that of any existing multiple port is added. To better understand this alignment variation, read steps A through E and J through M of the basic alignment procedure; then read the notes following steps E and M.*

3.17 To align a 244 Bridge network by this basic method, proceed as directed below. Reference the bold circled numbers in the procedure to their counterparts in the basic-method procedure diagram, figure 17. Figure 18 shows a 244 Bridge network aligned via this method. **Please note that levels indicated in figure 18 are data levels and are strictly hypothetical; those in your bridge network(s) will probably be different.**

Note 1: *It is assumed in the following procedure that the transmit and receive sections of the transmission measuring set (TMS) being used can be independently optioned for impedance.*

Note 2: *If a module is optioned for 150-ohm impedance and the TMS being used has a 135-ohm termination setting instead of 150 ohms, use the 135-ohm setting; the slight impedance mismatch will not affect level measurements appreciably. This is not true, however, when a module is optioned for 1200 ohms and the TMS for 900 or 600 ohms.* **To avoid setting levels erroneously in such cases, please be certain to observe the following:** *In applications where a module must be optioned for 1200 ohms to achieve a proper impedance match and the TMS has no 1200-ohm termination setting, option both the module and the TMS for 600 ohms during alignment. Then adjust levels as necessary, keeping in mind that actual levels will be* **3dB higher** *than those indicated on the TMS when the module is reoptioned for 1200 ohms after alignment.*

splitter channel:

A. Adjust the *splitter* and *combiner* precision attenuation switches on all 445X DDBT modules **1** for zero loss.

B. Arrange the transmit portion of a transmission measuring set (TMS) for 1000Hz tone output at the common-port input level specified on the circuit layout record (CLR) and, if possible, at the impedance selected for the 4451/51A/52A module's common-port facility interface. Connect this signal to the 4451/51A's *splitter facility* jack or the 4452A's *spl fac in* jack **2** .

C. Determine the worst-case multiple port, i.e., the multiple port with the lowest input level (due to the greatest amount of facility loss). In this procedure, we'll assume that this worst-case multiple port is port A **3** .

D. Arrange the receive portion of the TMS for a terminated measurement at the facility interface impedance selected for multiple port A on its 445X DDBT module. Connect the receive portion of the TMS to the *splitter facility out* jack of the port-A 445X module **4** .

E. Adjust the 4451/51A's *splitter level* control **5** (and splitter-channel gain-range option switches, if necessary) or the 4452A's *spl gain/loss* and *spl level* switches until the TMS reading at the port-A 445X module's *splitter facility out* jack **4** equals the CLR-specified output level toward the data station for multiple port A. Please note that the worst-case (i.e., port-A) 445X module's *splitter* attenuator switches were not reset from their minimum (zero) attenuation setting, nor will they be reset during the remainder of this procedure.

Note: *As an alternative to aligning for the greatest actual multiple-port facility loss in applications where future bridge-network expansion is expected, determine the greatest* **anticipated** *multiple-port facility loss and assume that, for this hypothetical worst-case multiple port, an associated 445X DDBT module's* splitter *attenuator switches are set for zero loss. Then set the splitter bus level to provide what would be the proper output level at this hypothetical multiple port, and set all 445X* splitter *attenuator switches in the existing bridge network to establish appropriate (CLR-specified) output levels at all actual multiple ports. This alignment method is advantageous in that it prevents the need for System realignment if a multiple port with greater facility loss than any existing multiple port is added after a bridge network is already installed and aligned.*

F. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the 4451/51A's *splitter out* jack or the 4452A's *spl brdg out* jack **6** . Measure and record the level, this is the splitter bus level, which must be known if and when future bridge-network expansion takes place.

G. Select *another* 445X DDBT module (for this procedure, we'll use the port-B 445X module). Arrange the receive portion of the TMS for a terminated measurement at the impedance selected on the port-B 445X module for that multiple port. Connect the receive portion of the TMS to the *splitter facility out* jack of the port-B 445X module **7**.

H. Adjust the port-B 445X module's *splitter* attenuation switches **8** until the TMS indicates the CLR-specified output level toward the station (modem).

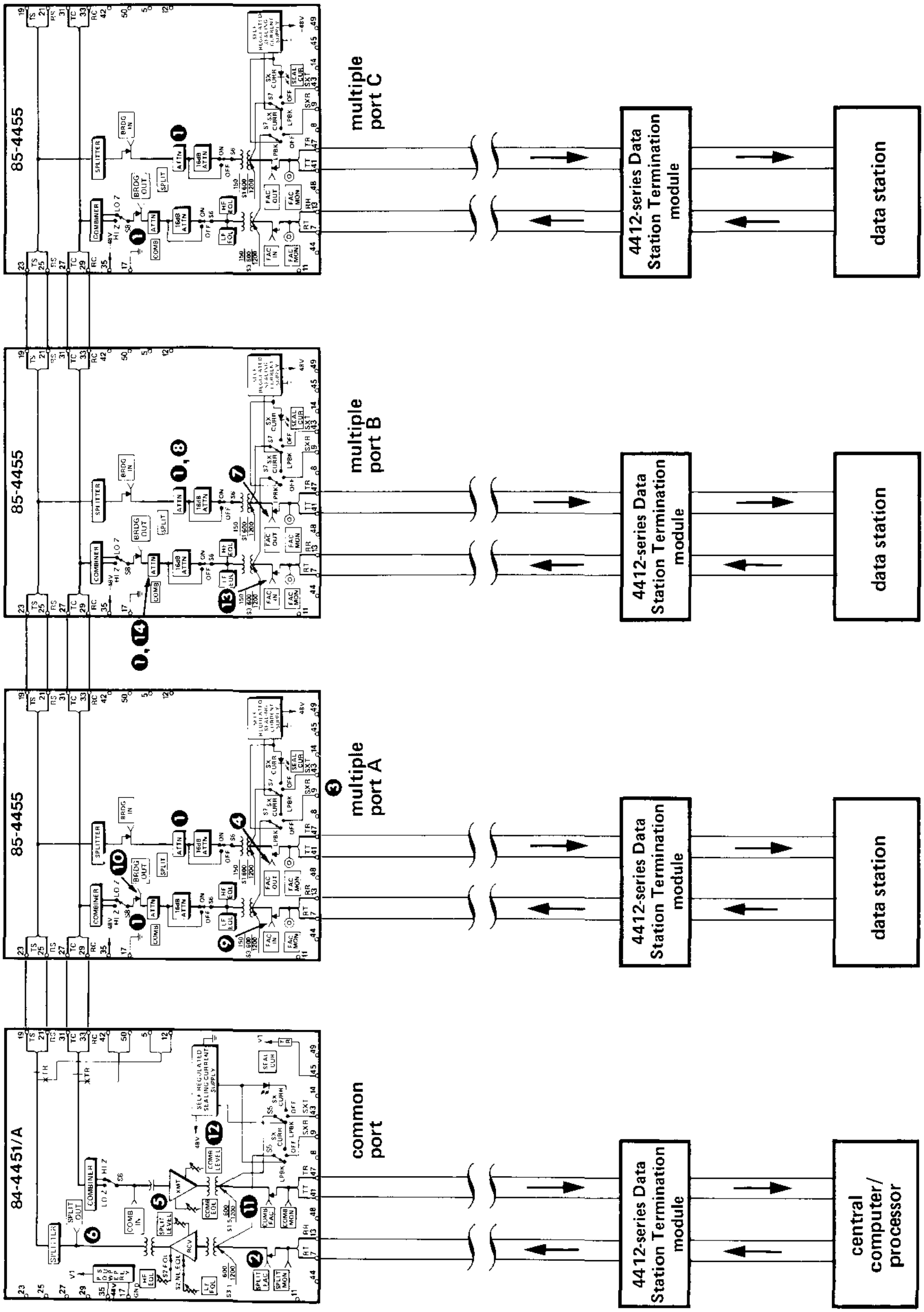
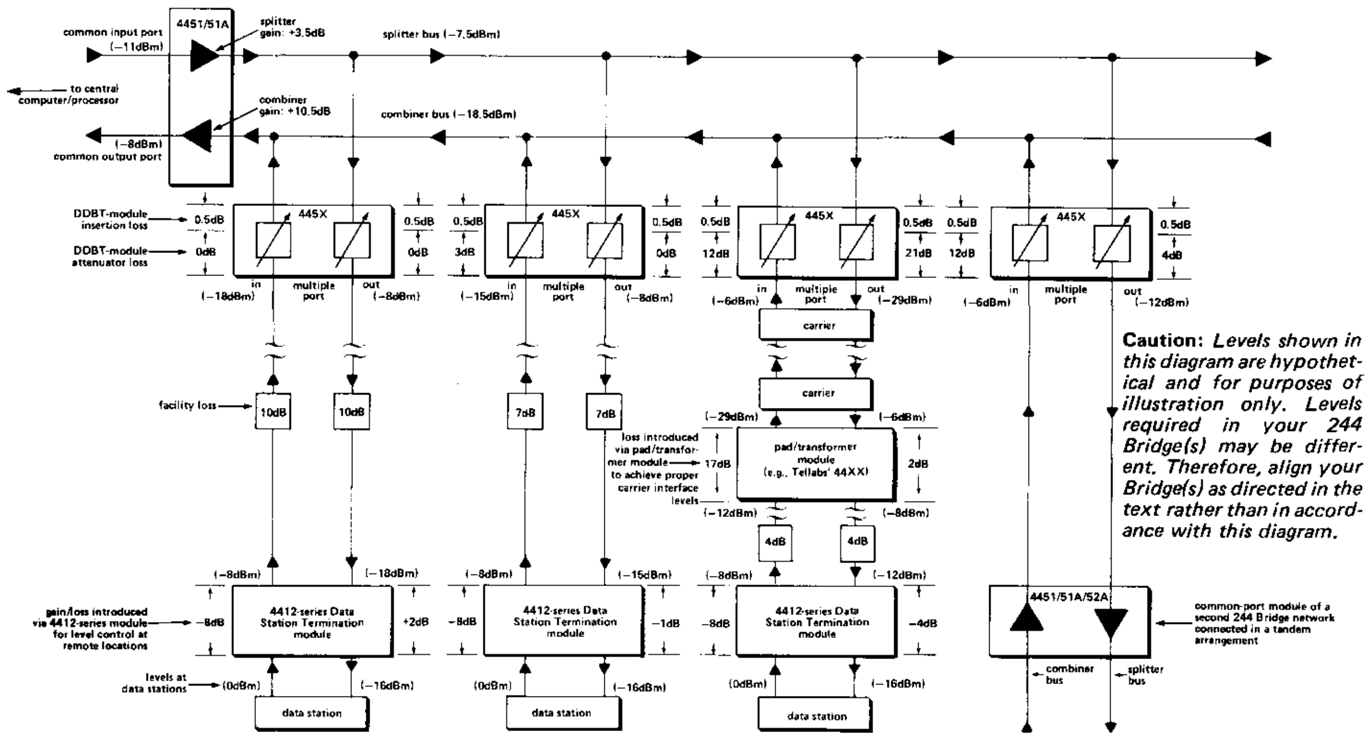


figure 17. 244 Bridge alignment procedure diagram for basic method (see paragraphs 3.16 and 3.17)



Caution: *Levels shown in this diagram are hypothetical and for purposes of illustration only. Levels required in your 244 Bridge(s) may be different. Therefore, align your Bridge(s) as directed in the text rather than in accordance with this diagram.*

figure 18. Hypothetical 244 Bridge network aligned by basic method (see paragraphs 3.16 and 3.17)

I. Repeat steps G and H for all other multiple ports (i.e., for all other 445X DDBT modules) in the bridge network. This completes alignment of the splitter path. Remove all test cords.

combiner channel:

J. Arrange the transmit portion of the TMS to output 1000Hz tone at a level equal to the lowest (i.e., worst-case) multiple-port input level (this should be specified on the CLR) and, if possible, at the impedance selected for the worst-case (i.e., port-A) 445X DDBT module's facility interface. Connect this signal to the port-A 445X module's *combiner facility in* jack **9**.

K. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the port-A 445X module's *combiner bridge out* jack **10**. Measure and record the level; this is the combiner bus level, which must be known if and when future bridge-network expansion takes place. Please note that worst-case (i.e., port-A) 445X module's *combiner* attenuator switches were not reset from their minimum (zero) attenuation setting, nor will they be reset during the remainder of this procedure.

L. Arrange the receive portion of the TMS for a terminated measurement at the impedance selected on the 4451/51A/52A DDB module for the facility interface, and connect the receive portion of the TMS to the 4451/51A's *combiner facility* jack or the 4452A's *comb fac out* jack **11**.

M. Adjust the 4451/51A's *combiner level* control **12** (and combiner-channel gain-range option switches, if necessary) or the 4452A's *comb gain/loss* and *comb level* switches until the TMS reading at the 4451/51A's *combiner facility* jack or the 4452A's *comb fac out* jack **11** equals the CLR-specified combiner-channel common-port output level.

Note: *As an alternative to aligning for the greatest* **actual** *multiple-port facility loss in applications where future bridge-network expansion is expected, determine the greatest* **anticipated** *multiple-port facility loss and assume that, for this hypothetical worst-case multiple port, an associated 445X DDBT module's* combiner *attenuator switches are set for zero loss. Then adjust the 4451/51A's* combiner level *control or the 4452A's* comb gain/loss *and* comb level *switches to provide the CLR-specified combiner-channel common-port output level. This alignment method is advantageous in that it prevents the need for System realignment if a multiple port with greater facility loss than any existing multiple port is added after a bridge network is already installed and aligned.*

N. Select a 445X DDBT module other than the worst-case (port-A) module (for this procedure, we'll use the port-B 445X module). Arrange the transmit portion to output 1000Hz tone at the CLR-specified input level for multiple port B and, if possible, at the facility impedance selected on the 445X module for multiple port B. Connect this signal to the port-B 445X module's *combiner facility in* jack **13**.

O. Adjust the port-B 445X module's *combiner* attenuation switches **14** until the TMS reading at the 4451/51A's *combiner facility* jack or the

4452A's *comb fac out* jack 11 is the same as that achieved in step M.

P. Repeat steps N and O for all other multiple ports (i.e., for all other 445X DDBT modules) in the bridge network. This completes alignment of the combiner path and, therefore, of the entire 244 Bridge network via the basic method. Remove all test cords.

alignment to establish predetermined bus levels

3.18 When aligning to establish predetermined bus levels (splitter channel first), the splitter bus level is set as specified by means of the splitter amplifier on the 4451/51A/52A DDB module. The output level of each multiple port is then set via the splitter attenuator switches on the 445X DDBT modules to provide the proper output level toward each data station. In combiner-channel alignment, the combiner output level at the common port is set as specified by means of the combiner amplifier on the 4451/51A/52A DDB module. The input level at each multiple port is then adjusted via the combiner attenuator switches on the 445X DDBT modules to provide the same level toward the bridge: the specified combiner bus level.

3.19 To align a 244 Bridge network for predetermined bus levels, proceed as directed below. Reference the bold circled numbers in the procedure to their counterparts in the procedure diagram for predetermined-bus-level alignment, figure 19. Figure 20 shows a 244 Bridge network aligned via this method to establish −5.5 and −29.5dBm data levels on the splitter bus and combiner bus, respectively. Please note that figure 20 includes a 4453 DDBT module used in its intended application, i.e., interfacing a carrier facility, and that the bridge network is aligned to establish appropriate bus levels for carrier interface. **Also, once again, please note that levels indicated in figure 20 are data levels and are strictly hypothetical; those in your bridge network(s) will probably be different.**

Note 1: *It is assumed in the following procedure that the transmit and receive sections of the transmission measuring set (TMS) being used can be independently optioned for impedance.*

Note 2: *If a module is optioned for 150-ohm impedance and the TMS being used has a 135-ohm termination setting instead of 150 ohms, use the 135-ohm setting; the slight impedance mismatch will not affect level measurements appreciably. This is not true, however, when a module is optioned for 1200 ohms and the TMS for 900 or 600 ohms.* **To avoid setting levels erroneously in such cases, please be certain to observe the following:** *In applications where a module must be optioned for 1200 ohms to achieve a proper impedance match and the TMS has no 1200-ohm termination setting, option both the module and the TMS for 600 ohms during alignment. Then adjust levels as necessary, keeping in mind that actual levels will be* **3dB higher** *than those indicated on the TMS when the module is reoptioned for 1200 ohms after alignment.*

splitter channel:

A. Adjust the *splitter* and *combiner* precision attenuation switches on all 445X DDBT modules 1 for zero loss.

B. Arrange the transmit portion of a transmission measuring set (TMS) for 1000Hz tone output at the common-port input level specified on the circuit layout record (CLR) and, if possible, at the impedance, selected for the 4451/51A/52A module's common port. Connect this signal to the 4451/51A's *splitter facility* jack or the 4452A's *spl fac in* jack 2.

C. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the 4451/51A's *splitter out* jack or the 4452A's *spl brdg out* jack 3.

D. Adjust the 4451/51A's *splitter level* control 4 (and splitter-channel gain-range option switches, if necessary) or the 4452A's *spl gain/loss* and *spl level* switches until the TMS reading at the 4451/51A's *splitter out* jack or the 4452A's *spl brdg out* jack 3 equals the CLR-specified splitter bus level.

E. Select any 445X DDBT module in the bridge network (in this procedure, we'll begin with multiple port A). Arrange the receive portion of the TMS for a terminated measurement at the facility interface impedance selected for multiple port A on its 445X DDBT module. Connect the receive portion of the TMS to the *splitter facility out* jack of the port-A 445X module 5.

F. Adjust the port-A 445X module's *splitter* attenuation switches 6 until the TMS reading at the module's *splitter facility out* jack 5 is equal to the CLR-specified output level for that multiple port.

G. Repeat steps F and G for all other multiple ports (i.e., for all other 445X DDBT modules) in the bridge network. This completes alignment of the splitter path. Remove all test cords.

combiner channel:

H. Arrange the transmit portion of the TMS for 1000Hz tone output at the CLR-specified combiner bus level and, if possible, at 600 ohms. Connect this signal to the 4451/51A's *combiner in* jack or the 4452A's *comb brdg in* jack 7.

I. Arrange the receive portion of the TMS for a terminated measurement at the impedance selected on the 4451/51A/52A module for the facility interface, and connect the receive portion of the TMS to the 4451/51A's *combiner facility* jack or the 4452A's *comb fac out* jack 8.

J. Adjust the 4451/51A's *combiner level* control 9 (and combiner-channel gain-range option switches, if necessary) or the 4452A's *comb gain/loss* and *comb level* switches until the TMS reading at the 4451/51A's *combiner facility* jack or the 4452A's *comb fac out* jack

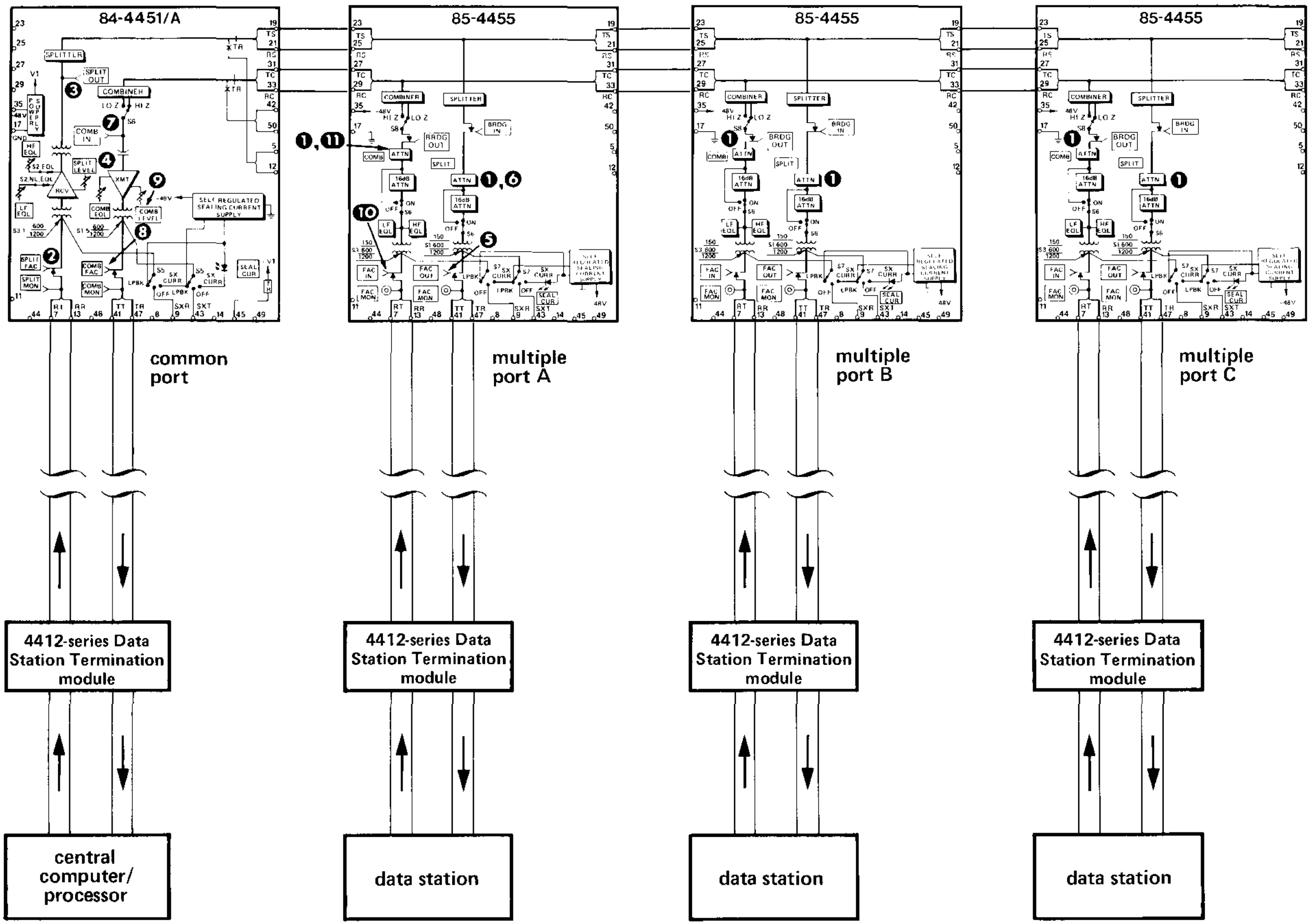


figure 19. 244 Bridge alignment procedure diagram for establishing predetermined bus levels (see paragraphs 3.18 and 3.19)

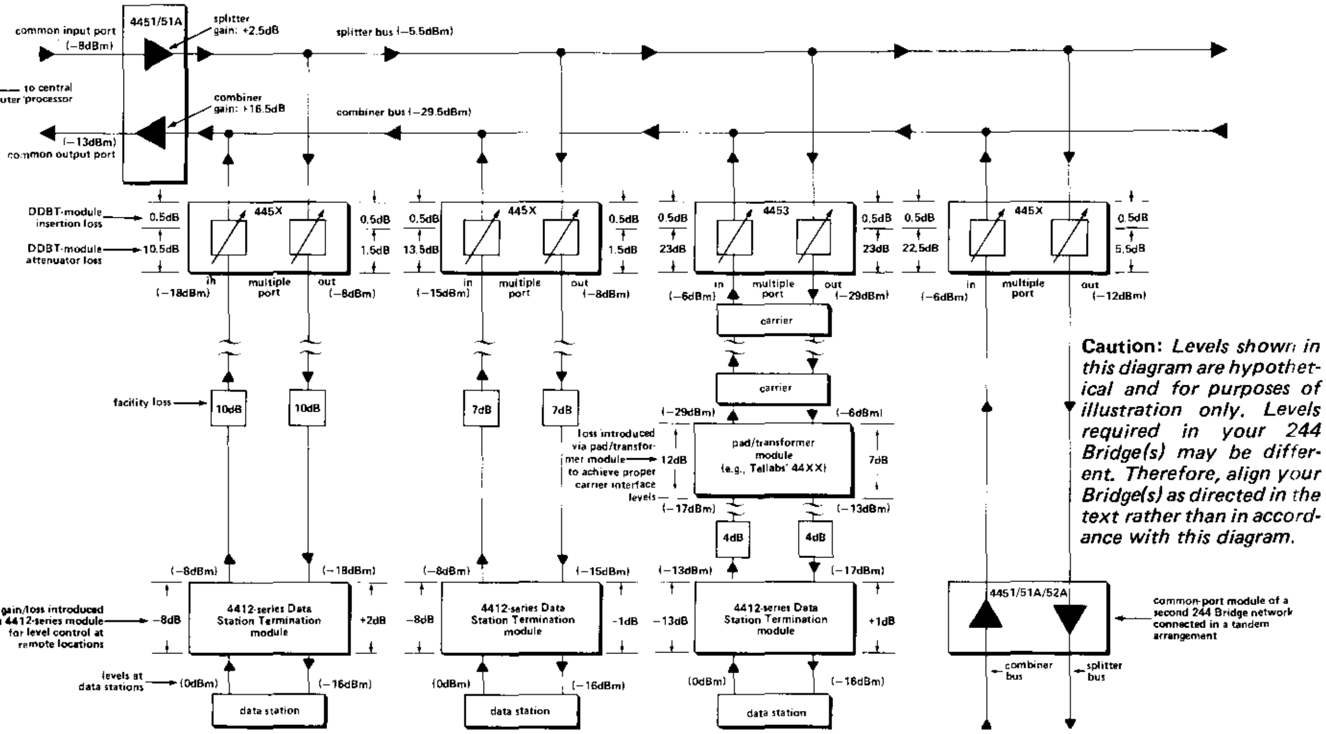


figure 20. Hypothetical 244 Bridge network aligned to establish −5.5 and −29.5dBm data levels on splitter and combiner busses, respectively (see paragraphs 3.17 and 3.18)

8 equals the CLR-specified combiner-channel common-port output level.

K. Select any 445X DDBT module in the bridge network (in this procedure, we'll begin with multiple port A). Arrange the transmit portion of the TMS for 1000Hz tone output at the CLR-specified input level for multiple port A and, if possible, at the facility interface impedance selected for multiple port A on its 445X DDBT module. Connect this signal to the port-A 445X module's *combiner facility in* jack 10 .

L. Adjust the port-A 445X module's *combiner* attenuation switches 11 until the TMS reading at the 4451/51A's *combiner facility* jack or the 4452A's *comb fac out* jack 8 is the same as that achieved in step J.

M. Repeat steps L and M for all other multiple ports (i.e., for all other 445X DDBT modules) in the bridge network. **Ensure that no 445X modules are left unaligned.** This completes alignment of the combiner path and, therefore, of the entire 244 Bridge network via the method for accommodating predetermined bus levels. Remove all test cords.

4. system wiring diagram

4.01 For ease of use, the 244 Distributive Data Bridge System wiring diagram is presented as a fold-out on the last page of this Practice.

5. specifications

Note: *For specifications of modules used in the 244 System, see respective Practices on these modules.*

combiner channel (multiple ports to common port)

combiner-channel level variation (from minimum to maximum number of multiple ports in one 24X Assembly)
1dB maximum variation (at same combiner-channel level setting), 1 to 26 multiple ports

delay distortion
less than 200 microseconds, 400 to 3000Hz

frequency response
±0.5dB re 1kHz level, 300 to 4000Hz

splitter-channel (common port to multiple ports)

splitter-channel level variation (from minimum to maximum number of multiple ports in one 24X Assembly)
1dB maximum variation (at same splitter-channel level setting), 1 to 26 multiple ports

delay distortion
less than 200 microseconds, 400 to 3000Hz

frequency response
±0.5dB re 1kHz level, 300 to 4000Hz

power requirements

input voltage
−42 to −56Vdc, ground referenced

input current
dependent upon number and types of 244-System modules in 24X Assembly. See individual-module Practices for current requirements of each.

physical

operating environment
20° to 130°F (−7° to 54°C), humidity to 95% (no condensation)

dimensions
height: 5.92 inches (15.04cm)
depth: 7.31 inches (18.57cm)
width (less mounting ears):
24XA: 17.50 inches (44.45cm)
24XB: 20.40 inches (51.82cm)

weight (without modules)
24XA: 5.5 pounds (2.5kg)
24XB: 6 pounds (2.7kg)

mounting
24XA (12 module positions): mounts in 19-inch relay rack occupies 6 inches of vertical rack space
24XB (14 module positions): mounts in 23-inch relay rack, occupies 6 inches of vertical rack space

6. testing and troubleshooting

6.01 The Testing Guide Checklist in this section can be used in the installation, testing, or troubleshooting of the 244 Distributive Data Bridge System. The Checklist identifies the most common types of general trouble conditions, with suggestions as to the probable causes. For specific signaling or transmission difficulties, consult the appropriate individual module Practices. A detailed Testing Guide Checklist and a functional block diagram for each 244-System module are included in these Practices. If a module is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted on any 244-System module or on the 24X Mounting Assembly. Unauthorized testing or repairs may void the module's or Assembly's warranty.

Note: *Warranty service does not include removal of permanent customer markings on the front panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked* **defective**, *we recommend that it be done on a piece of tape or on a removable stick-on label.*

6.02 If a situation arises that is not covered in the Checklist, contact Tellabs Customer Service at your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, Headquarters. Telephone numbers are as follows:

US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (702) 827-3400
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

6.03 If any 244-System module or a 24X Assembly is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is more expedient, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

6.04 To obtain a replacement 244-System module or 24X Assembly, notify Tellabs via letter (see addresses below), telephone (see numbers above), or twx (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X445X(a), 8X24XA, or 8X24XB part number that indicates the issue of the item in question. Upon notification, we shall ship a replacement to you. If the item in question is in warranty, the replacement will be shipped at no charge. Pack the defective item in the replacement item's carton, sign the packing slip included with the replacement, and enclose it with the defective item (this is your return authorization). Affix the preaddressed label provided with the replacement to the carton being returned, and ship the item prepaid to Tellabs.

repair and return

6.05 Return the defective 244-System module or 24X Assembly, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532

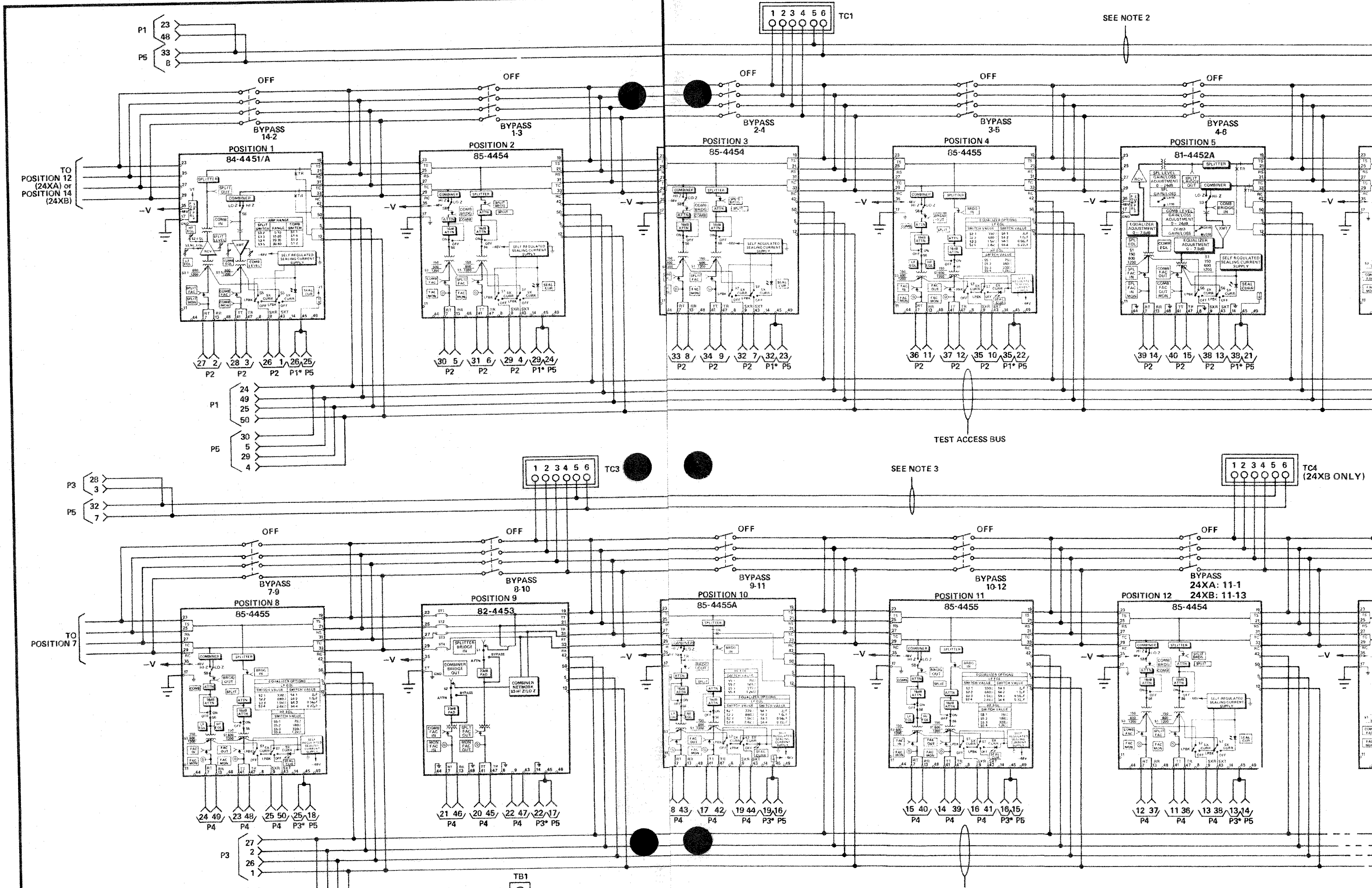
in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 39
Mississauga, Ontario, Canada L4W 2S7

Enclose an explanation of the item's malfunction. Follow your company's standard procedure with regard to administrative paperwork. Tellabs will repair the item and ship it back to you. If the item is in warranty, no invoice will be issued.

testing guide checklist

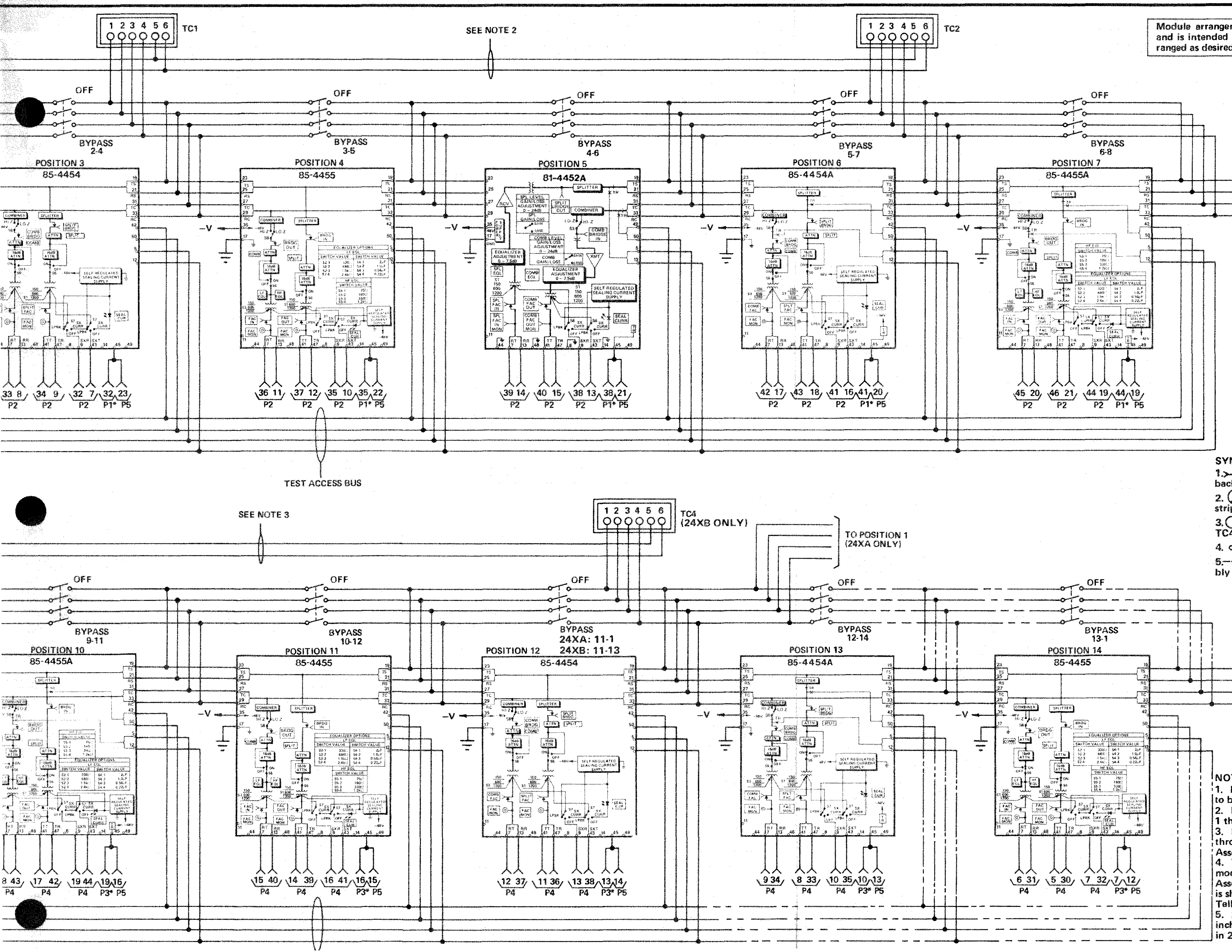
trouble condition	possible cause (in order of likelihood)
system inoperative (transmission not occurring)	1) Power connection faulty ☐. Verify power output (–42 to –56Vdc) by measuring voltage between negative (–) and positive (+) terminals on connector at rear of 24X Assembly (see paragraph 3.05) ☐. 2) Bypass switches incorrectly set ☐. 3) External wiring incorrect ☐.
excessive noise in transmission path	1) Improper grounding, especially existence of ground loops ☐. 2) Amplifier levels in 4451/51A/52A misaligned ☐. 3) Unbalanced facility terminations ☐. 4) Defective 4451/51A/52A module. Substitute new module and retest ☐.
inability to derive proper transmission levels	1) Improper port and combiner-bus impedance optioning of DDBT module(s) ☐. 2) Signal levels exceeding overload limits of 4451/51A/52A ☐. 3) Defective 4451/51A/52A module. Substitute new module and retest ☐.
trouble at multiple port served by one DDBT module	1) See practice on DDBT module for troubleshooting instructions ☐.

4. wiring diagram



*Connectors P1 and P3 are generally not used with 244 System (see table 1 of this Practice).

Module arrangement in this wiring diagram should be considered typical and is intended for example only. Modules in an actual System may be arranged as desired, consistent with the guidelines presented in this Practice.



SYMBOLS:

1. >— denotes female cable connector on 24X Assembly backplane.

2. ⊘ denotes screw terminal on two-position power barrier strip on 24X backplane.

3. ○— denotes wire-wrap terminal of 6-pin blocks TC1 through TC4 on 24X backplane.

4. o— denotes pin of 56-pin module connectors in 24X Assembly.

5. ----- denotes wiring that appears on 24XB (14-position) Assembly only.

NOTES:

1. Bypass switches on 24X backplane allow circuit continuity to be maintained through vacant module positions.

2. Indicated pair connects to pins 37 and 39 of module positions 1 through 7 for future applications.

3. Indicated pair connects to pins 37 and 39 of positions 8 through 12 of 24XA Assembly or positions 8 through 14 of 24XB Assembly for future applications.

4. Thirteen-pin local-test-access block TL1 is located behind module position 12 of 24XA Assembly or position 14 of 24XB Assembly. This terminal block is not shown in this diagram but is shown in the 24X backplane schematic included in the separate Tellabs 24X Mounting Assembly Practice (section 8X24X).

5. 24XA Assembly has 12 module positions and mounts in 19-inch racks; 24XB Assembly has 14 module positions and mounts in 23-inch racks.