

*Bell Labs engineers have reduced the cost of a dial private branch exchange (PBX) by using existing technology—crossbar switches and solid-state circuitry. Aimed at small businesses requiring as many as 57 extensions, the 805A is easy to install and maintain.*

# The 805A PBX— A Switching Bargain For Small Businesses

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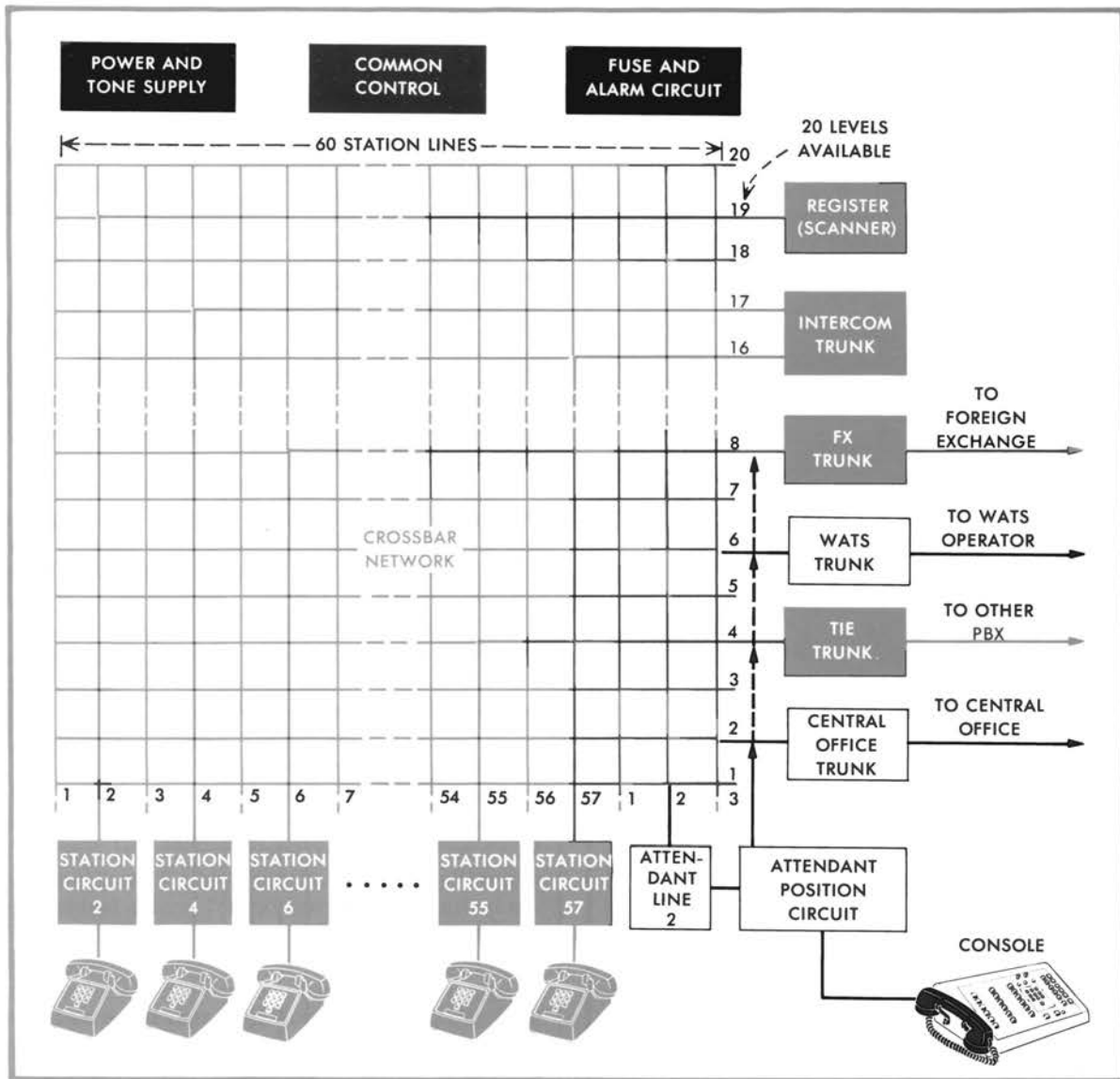
ALL OPERATING COMPANIES have small business customers who would like to have a dial private branch exchange (PBX) of modest size, but have had to settle for smaller, less useful, manual PBX systems. In many cases, the flexibility provided by larger, more comprehensive PBX systems is not worth the additional cost. But now there is an alternative—the 805A PBX, which has been designed at the Bell Laboratories Denver location to meet the demand for low-cost basic PBX service. The new PBX, which uses existing technology and emphasizes maintainability, has been in production for over a year and has gained rapid acceptance wherever appropriate tariffs have been filed—in fact, New Jersey Bell marketing people have dubbed it “The Grabber” because of its ability to grab sales.

The 805A PBX serves a maximum of 57 telephones (or “stations”) with a console the size of a small CALL DIRECTOR® telephone and a switching unit about the size of a pair of filing cabinets. All standard 100 series PBX features, and several optional features, are available (see the table on page 139). Everyone served by the PBX can, with two digits, dial other internal telephones on inter-

com trunks, and those with unrestricted telephones (having access to both inside and outside trunks) can gain access to the central office to place outside calls by dialing a single digit. People using restricted telephones, on the other hand, require the attendant’s assistance to make outside calls; the attendant can complete the call or allow the restricted station user to dial the number himself.

The 805A is the first Bell System PBX that combines integrated circuitry in the control unit with a crossbar switching network. Integrated circuits make the equipment compact, highly reliable, and easy to maintain. And the crossbar switch is the same one used in No. 5 crossbar central offices.

Careful circuit design led to further economies in the 805A PBX. For example, the designers chose a single-voltage power supply—delivering 24 volts—for simplicity and resulting low cost. Then they designed all the logic circuits, relays, and crossbar networks to operate at that single dc level. Inexpensive solid-state circuitry and a simple mechanical interrupter provide tones and lamp signals. A multivibrator provides dial tone. The multivibrator’s output is filtered, with simple circuits,

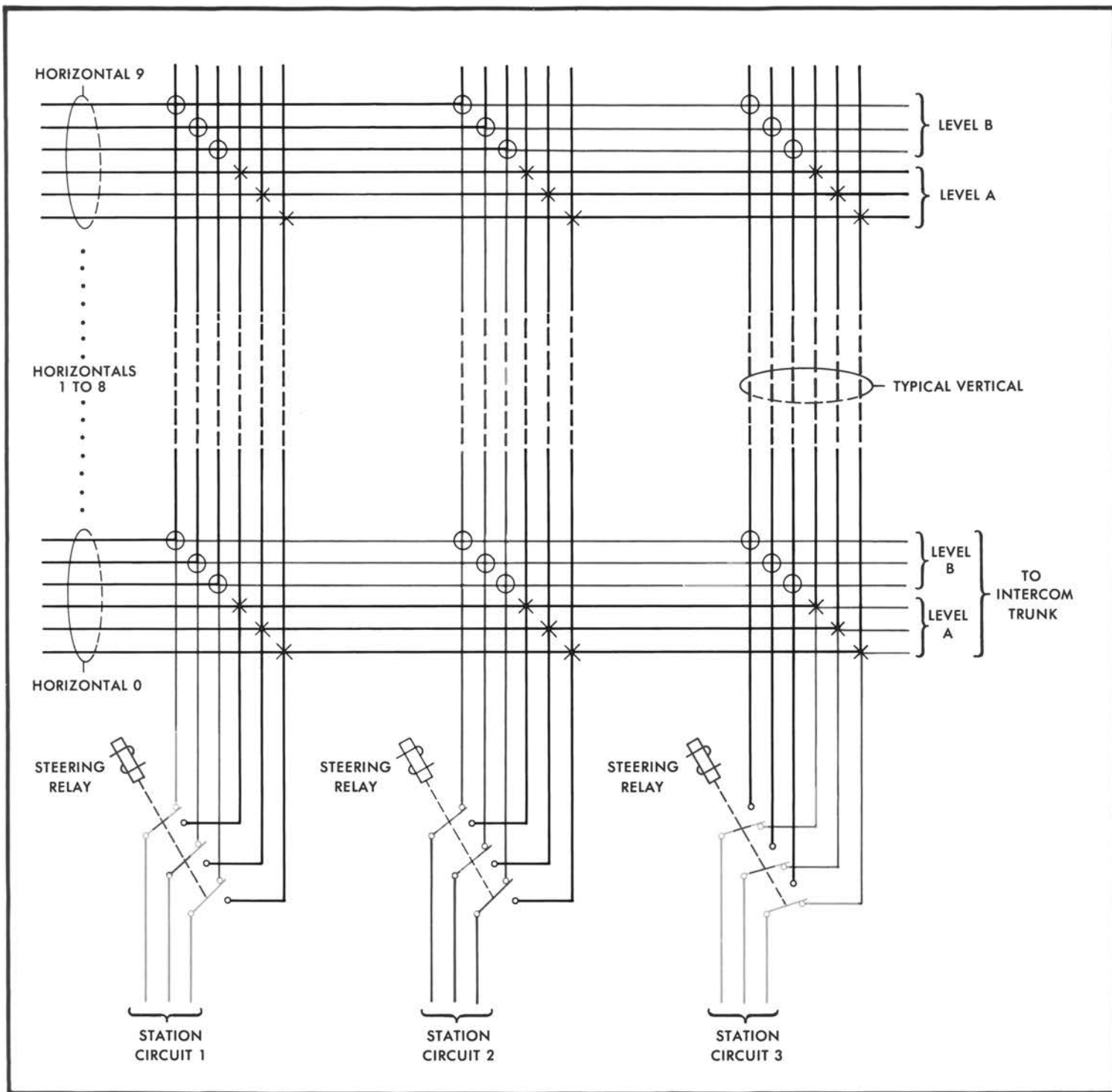


Six crossbar switch units, each serving 10 stations, are wired together to provide a 60-terminal capacity for the 805A. The 57 stations and three attendant lines are terminated at the 60 verticals of the crossbar, while trunks and registers are con-

nected to the 20 horizontals. Two of the 20 levels are reserved for registers, leaving 18 for trunks. Each intercom trunk requires two levels—one each for the calling and the called parties. Up to 18 stations can be involved in calls at the same time.

to avoid interference with TOUCH-TONE® frequencies. Finally, the designers used several dual-function circuits to further reduce the cost. For example, a single circuit scans for stations requesting service and acts as a register to store the number of the desired party when a user dials a number. Two such circuits are standard in the

805A. The two register circuits are similar to the one used in the 800A PBX (an electronic switching system for up to 80 lines), but the 800A and other 800-type systems have autonomous scanners (see *Electronic Switching for Small PBXs*, RECORD, February 1967). The trunk interface circuit is another dual-function unit. This circuit



Each crossbar switch in the 805A is a 10-by-10 switch (100 switch points) with six wires per switch point. Each station uses three of the six wires, with a steering relay (bottom) controlling which three are used. The relays thus double the available horizontal levels to 20. In the section of the crossbar switch shown,

the user of station circuit 1 is talking, through level B of horizontal 0, to the user of station circuit 3, who is on level A. An intercom trunk circuit connects the two users. Station circuit 2 is connected, via level B of horizontal 9, to an outside line (the central office, a WATS line, a foreign exchange, or another PBX).

*The 805A is built in a single cabinet. All circuitry is mounted on two slides for ready accessibility—one slide (shown extended) holding power supply, electronic circuitry, and two crossbar switch units. Another slide, mounted behind the one shown, holds four crossbar units. The 805A's standard and optional features are listed below the photo.*

serves central office trunks as well as tie trunks.

A simple transformer-rectifier unit, connected to the customer's 60-hertz service, provides 24-volt dc power for the 805A. This single-voltage supply serves all PBX requirements except for external calls, which are powered from central office trunks. The standard power supply may be replaced with a unit that has a wide frequency tolerance for use with customer-owned generators, which do not produce exactly 60 Hz. If total power failure occurs, the PBX will go out of service, but four telephones will be automatically connected to external trunks for emergency communication. An optional battery power supply will also be available. This unit will be able to power the PBX for more than eight hours when normal power is disrupted.

The 805A, when fully equipped, has 57 station lines, three attendant lines, two registers, and one common controller (the basic control unit for the PBX). In addition, there is space for up to 12 external trunks, which may be a mixture of trunks for central offices, foreign exchanges (central offices outside the local area), WATS (wide-area telephone service), or tie trunks to other PBX machines. Three intercom trunks are included if all 12 external trunk positions are used, but four can be provided if 10 or fewer external trunks are needed. Up to 18 stations can be involved in calls at the same time. Studies have shown that these arrangements should provide sufficient traffic-handling capability to satisfy over 50 percent of the potential customers for small PBXs.

When an 805A user lifts the receiver to call another station, a scanner identifies the off-hook signal and reports it to the common controller (see the illustration on page 137). The controller connects the caller's line to an idle register through the crossbar switch. The register gives the caller dial tone, and he can then dial the two-digit number (between 11 and 69—the numbers for internal stations). After receiving the number, the register alerts the controller, which in turn connects the called and calling stations to an intercom trunk. Simultaneously, the controller sends a ringing current through the trunk to the called



## 805A PBX SYSTEM FEATURES

### STANDARD

- Station-to-station calling
- Direct outward dialing
- Call transfer (by attendant for all central office calls)
- Outgoing call restriction
- Station hunting (consecutive, circular)
- Night service (4 station-fixed)
- Power failure transfer (4 station-fixed)
- Connections for traffic measuring equipment
- Attendant console
- Through dialing
- Straightforward outward completion
- Direct trunk terminations
- Alarm indications
- Self-contained test and status panel

### OPTIONAL

- Paging by attendant
- TOUCH-TONE® calling
- Foreign exchange trunk access
- WATS trunk access
- Wide frequency-tolerance power supply
- Reserve power
- Tie trunks-2-way ringdown, 2-way dial repeating, dial out/automatic-in

station and a ringback signal to the calling station.

If the internal station user wishes to call the attendant, he dials the single-digit code "0" and the controller connects an idle attendant line to an intercom trunk. The controller then connects the calling station to the intercom trunk, flashes a lamp, and rings the bell at the attendant's console.

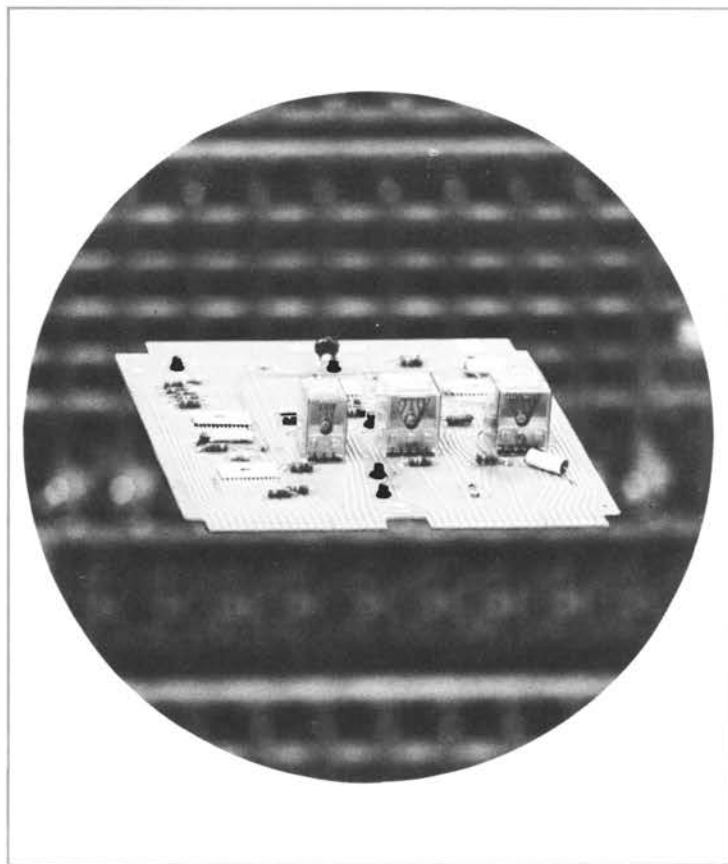
If the caller wishes to make a call on one of the external trunks, he dials the proper single-digit code for that trunk—9, 8, 7, or possibly 6 (if station numbers 60 to 69 are not used)—and the common controller selects an idle external trunk of the type associated with the dialed code and connects it to the calling station via the crossbar switch.

A restricted user also has a straightforward means for making external calls. He can have the attendant place an outside call by dialing "0" and telling the attendant the number he wishes. The attendant puts the caller on "hold" and dials the desired number on an idle central office trunk. Then, by pressing a transfer key, the attendant connects the trunk and the caller through the crossbar switch. The attendant may also connect the caller to an idle central office trunk and allow him to dial the desired number.

Incoming calls appear at the console without any switching action, since the attendant's console has direct connections to all external trunks. Responding to a bell and a flashing lamp, the attendant answers the calls by pressing the flashing trunk button. After the caller identifies the desired party, the attendant connects the calling party and the station through the crossbar switch. When either party hangs up, the 805A automatically releases the connection.

The 805A is equipped for station hunting—that is, when an incoming call is intended for a station that is busy, the 805A will locate an idle station in the busy station's group (any number of stations can be arranged into any number of groups). For "circular" hunting, the 805A tries each station in a group in a preset order, starting at the station called. Hunting proceeds from there to the end of the group and then starts over at the beginning. If the customer wants hierarchal-type hunting (where, for example, a supervisor's call will be routed to one of his subordinates but not vice versa), then "terminal" hunting can be arranged, where the 805A only scans in one direction to the end of the group as it searches for an idle station.

The designers simplified the central office trunk circuits by making them universal two-way circuits that will interface with any type of central



*The 805A uses proven parts such as hybrid integrated circuits and discrete components. The printed-circuit board is the same size as those used in the other 800-type PBX systems. Mounting all circuits on printed circuit boards speeds troubleshooting procedures, since complete circuit boards can be easily replaced.*

office—ESS, crossbar, etc. (Other PBXs have different trunk-circuit configurations for different central offices.) Each trunk circuit is contained on one and a half circuit packs (each about 7 × 8 inches). The universal trunk circuit also serves as the basis for interface circuits for tie trunks, making these circuits smaller and less expensive.

Three types of tie trunk circuits to remote PBXs are scheduled to be introduced as options: (1) a



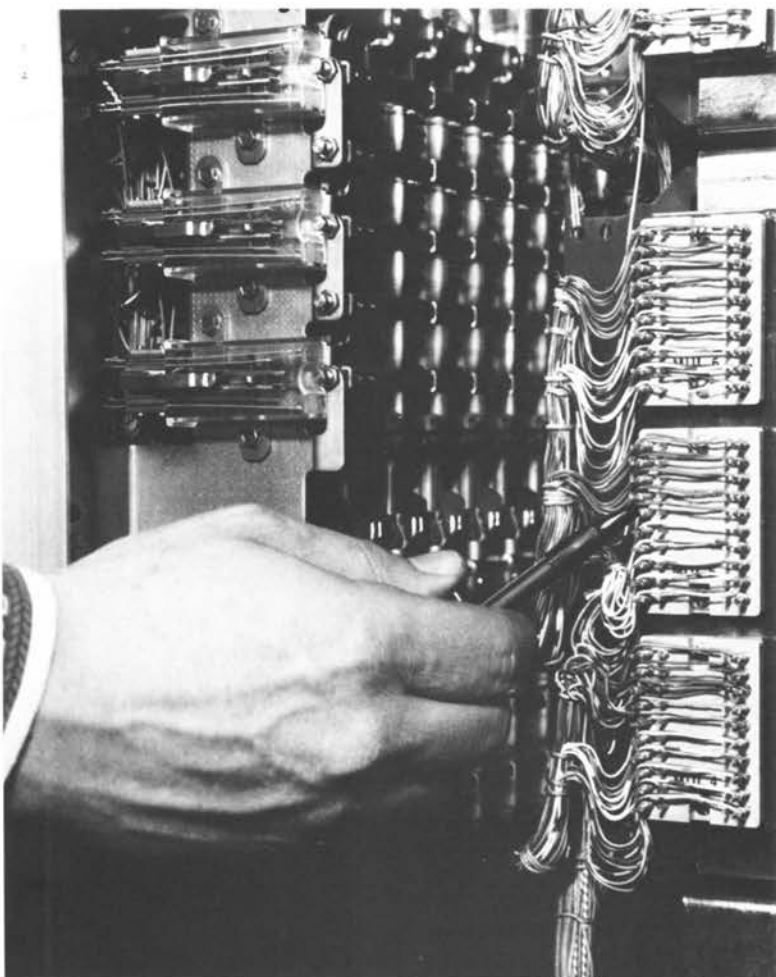
*Raymond Dellecker and David Weiner, above, test a prototype model of the 805A at Bell Labs' Denver location. One of the slides, holding the power supply and electronic circuitry, is shown extended from the cabinet. The other slide is visible through the space left by the extended slide. In the right-hand photo, Weiner (formerly of Bell Labs' Denver facility, now with AT&T), examines the crossbar switching units. The crossbar is the same as those used in No. 5 crossbar central offices.*



two-way dial repeating trunk (by which the local user dials his party directly through the remote PBX); (2) a two-way ringdown trunk (by which a ringing signal is transmitted to the attendant at the remote PBX, who then completes the call); and (3) a dial-out/automatic-in trunk (by which the local user can dial out, but an attendant handles incoming calls). A maximum of two tie trunks, in any combination, may be added to the 805A, but

each one displaces a central office trunk. Each two-way dial repeating tie trunk also displaces one line that normally serves a station.

The 805A's physical arrangement meets the objectives of low cost and simplicity. A single cabinet holds the equipment for a full system (the cabinet is the same type as is used for the 756A PBX, an older, more elaborate crossbar PBX handling about the same number of lines as the 805A).



*A test probe, permanently wired into the 805A cabinet, detects logic voltage levels and open-circuit conditions. It also stretches short pulses that light lamps to allow recognition of signals.*

Both sides and front of the cabinet have easily removable covers for ready accessibility, and the equipment is mounted on a pair of pull-out slides. Two crossbar switches, the power supply, and electronic circuitry are mounted on one slide, and the other slide contains another four crossbar switches, Touch-Tone receivers (one per register), and the cross-connect field (an assembly of terminal strips on which wired interconnections are made). Maintenance personnel can examine fuses and status lamps without withdrawing either slide.

Crossbar switches are added in two stages as the number of station lines increases. The basic 805A system has one network assembly, consisting of two crossbar switches and 20 steering relays. Another assembly is added when the customer's

station lines exceed 18, and a third is added when more than 37 are required (a fully equipped cabinet is shown in the photo on page 139).

The 805A is easy to maintain because of its built-in simplicity and added maintenance features. All solid-state circuitry for a basic system is contained on 15 different types of printed circuit boards; a total of 47 boards is required for maximum capacity. Since the electronic portions of the 805A system are on standard circuit packs, they can be quickly replaced if necessary.

A maintenance panel is built into the cabinet to aid troubleshooting. The panel contains a bank of status lamps for all trunks, registers, and attendant lines. When the bank is energized by the maintenance person, the lamps identify busy circuits and enable the repairman to direct test calls to specific equipment to follow the progress of calls. A test probe, built into the cabinet, allows thorough testing. The probe detects logic voltage levels, open-circuit conditions, and also stretches short pulses to light lamps long enough to allow time to recognize the signal. Troubleshooting is further simplified since each station line is wired to the corresponding position on the crossbar switch.

Simplified maintenance instructions also ease repair. A flowchart-style Bell System Practice (BSP) guides a repair person to the appropriate circuit pack that should be replaced. For more difficult troubles, the chart guides the person to the appropriate point in the sequence charts that are included with the schematic drawings. Test points, labeled in the sequence charts, identify the signals that the person should observe when using the built-in test probe.

Both ordering and installation have been simplified with a new questionnaire. A computer will generate specific ordering information and installation instructions based on the information in the questionnaire. Western Electric in Denver then uses the computer's instructions to assemble and thoroughly test each system. This procedure enhances the initial reliability of the system by ensuring that the system, as received at the customer's location, will pass the installation tests dictated by Bell System Practices. The absence of options on the circuit packs eliminates one of the major installation problems, and an installer can normally install and check out the PBX in a day.

Such installation features, combined with easy maintenance and low cost, are among the reasons why customer acceptance has been excellent according to New Jersey Bell. The 805A should continue to prove itself as a basic, reliable, low-cost PBX for the small business.