

The new, 1A2 Key Telephone System is a completely modernized version of older equipment. Using solid-state circuitry and miniature relays, it performs better and more economically than older key systems, and introduces some new services.

Key Telephone Systems: The Latest Chapter

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THE BELL SYSTEM had a total investment of about 100 million dollars in key telephone systems at the end of 1950. By 1957 the figure had grown by about 200 millions. In 1964 alone the investment increased by well over 200 million dollars. This rapidly accelerating growth is directly attributable to the acceptance, by American business, of the enormous value of fast and flexible communications. The recently designed 1A2 Key Telephone System is the latest step in making this service even more valuable as well as less costly.

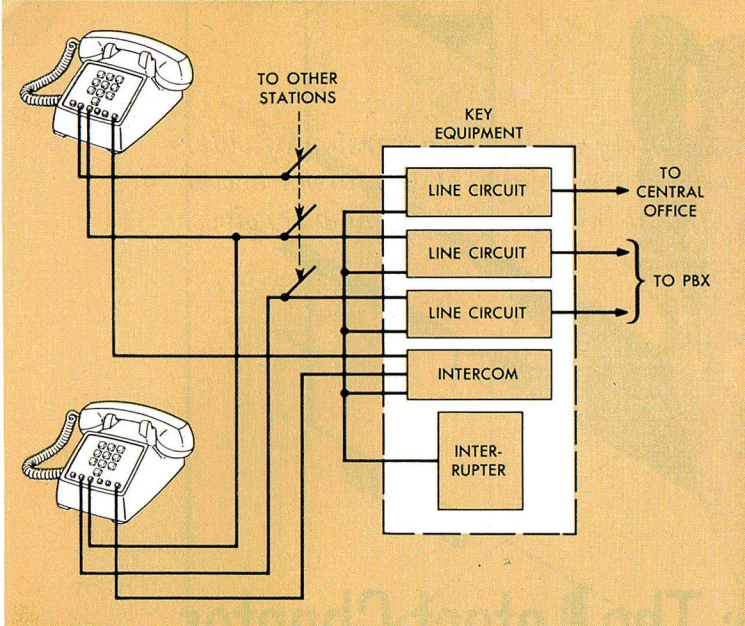
A key telephone system is a customer-controlled switching system. Basically, it permits using a station set for more than one telephone line by switching from one line to another, but a wide variety of service features make it a communications facility of great versatility. Customers can signal from one station to another, transfer calls between stations, hold a call on one line while talking on another, and converse between stations without tying up a central office or PBX line.

Four different types of station sets are commonly used with key systems. The simple turn-button phone handles only two lines; the familiar

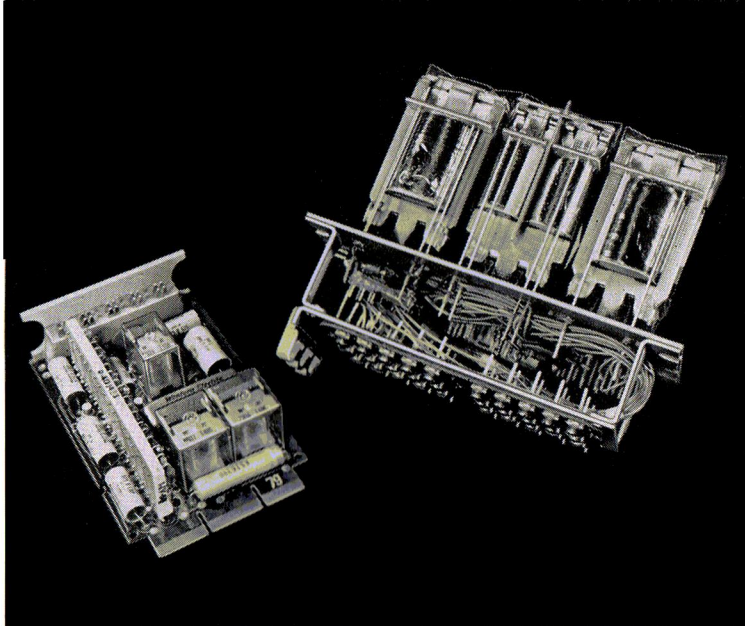
pushbutton "560 set" handles up to six lines, and the CALL DIRECTOR® telephone handles from six to 30. For even greater requirements, flush-mounted key panels can terminate from six to 120 lines—this is the largest single key mounting the Bell System makes, but even more lines can be added by using more than one mounting.

The Bell System's first key system, the 1A, was developed at Bell Laboratories in 1938 (RECORD, June 1940). Though limited to six lines, it was designed on the "building block" principle for expandability. Each telephone line connected to the system required a relay assembly, or "line switch," no matter how many station sets had access to it. Other assemblies controlled the service features, which could be altered by changing assemblies. The line switches and other units came to be known as Key Telephone Units, or KTUs.

The building block principle prevailed when the system was redesigned in 1952. The new design, known as the 1A1 (RECORD, April 1956), was particularly aimed at making larger systems (more than six lines) lighter, more economical, and easier to install. It included a new line switch



One line circuit furnishes key service for one central-office, PBX, or intercom line, no matter how many station sets are connected to the line. An interrupter controls the audible and visual signals.



In the 1A2 key telephone system a plug-in circuit card replaces a more cumbersome assembly. Shown are comparable central-office and PBX line circuit KTUs for the 1A1 and 1A2 systems.

with four relays instead of the previous five, a cabinet designed for more efficient installation and maintenance, and several factory-wired packages of interconnected KTUs for various combinations of numbers of lines and types of service.

Two new service features were added with the 1A1: a winking signal for lines being held, and a dial-selective intercommunication system. The original 1A system had only one visual signal—a lighted lamp to indicate a line in use. (Signal lamps are usually under the pushbuttons that control the lines, though they may be located elsewhere.) This was later modified so the signal lamp at every station where a line appeared would flash (about a half-second on and a half-second off) when the line was ringing. With the 1A1 a third signal was added to indicate a line being held—a winking lamp (off for about one-twentieth of each half-second) at every station where the line appeared.

The dial-selective intercommunication system, which would with later modifications become the 6A system (RECORD, March 1958), consisted of a separate “intercom” line connected between station sets of the system but not to a PBX, central office, or other external line, and a dial signaling system. It permitted signaling any of nine different codes (a code could mean one or more stations) by selecting the intercom line with a pushbutton and dialing a single digit (“1” was not used, hence only nine codes). When the dial intercom system became the 6A, it was changed

to permit up to 80 lines by dialing two-digit numbers or using direct selection keys. Signaling at the selected station consisted of an audible signal (bell or buzzer) and flashing lamp, with a steady lamp at all other stations to indicate the intercom line was in use.

From the user’s point of view the 1A2 is not much different from the 1A1. Inside, however, it is a completely new system, streamlined and modernized in circuits and equipment. Solid-state components, printed-wiring boards and miniature relays have replaced older types of equipment. A complete new set of KTUs consists of plug-in circuit boards, far smaller and lighter than the older units. Printed wiring has eliminated most of the internal wiring of the individual units, and the plug-in boards have eliminated the old screw-terminal wiring that was used to connect units in the 1A and 1A1 systems.

The new system is also easier to install and maintain. Not only are the plug-in units easier to install than the screw-terminal types, but the “package” concept has been continued in the design of mountings for the KTUs, and the packages are also easier to install. Most repairs can be made by replacing plug-in units, and service changes only require adding or changing KTUs and possibly the larger packages.

The basic unit of the new system is the line switch for central office and PBX lines, the 400 KTU. Functionally similar to the line circuit in the 1A1 system, this unit furnishes standard key system switching for one central office or PBX

line. The services include picking up the line at any associated station set, holding the line while the station set is disconnected from it, and visual signaling from a lamp beneath the line button.

The 400 KTU also incorporates a new feature—long in demand but heretofore impractical to provide—individual line timeout. This means that visual and audible signals are separately controlled for each line rather than commonly controlled as in the past. With the 1A1 system the lamp and ringer associated with a line being signaled kept operating, even after the caller gave up his efforts to complete the call, until all the lines in the system were idle unless someone picked up the called line to interrupt the circuit. In the 1A2 system the signaling stops after a brief timeout period. The period can be long (nominally 30 seconds) or short (nominally 18 seconds), depending on the use of an easily-installed strap on the KTU. A new design, the 400D KTU will permit reducing the short period by about 75 per cent by installing a single resistor.

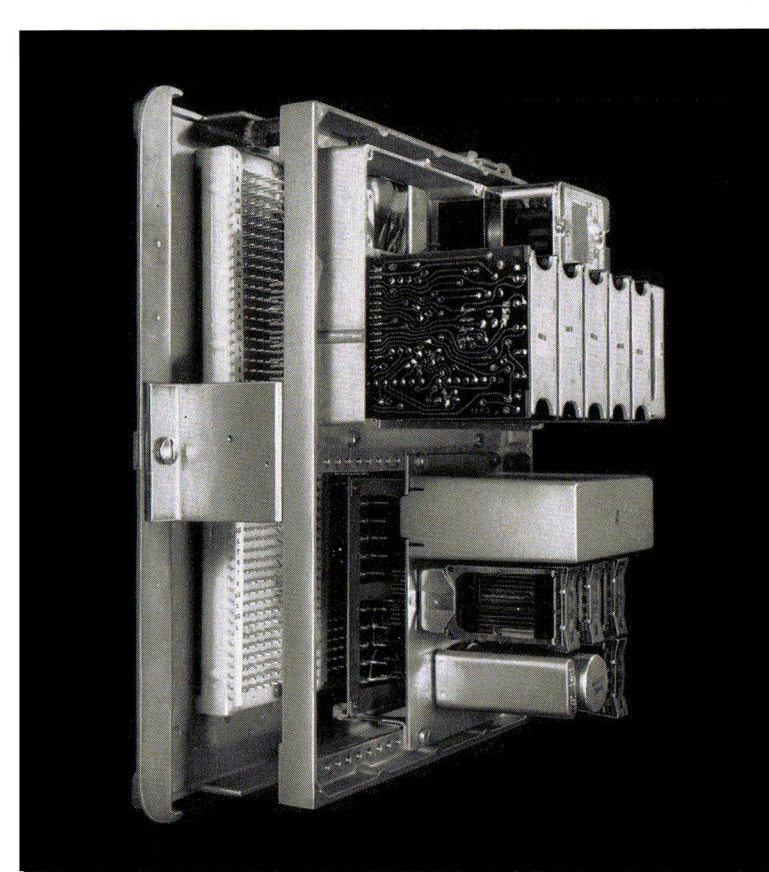
The 401 KTU provides manual local intercommunication service. On this type of line, signaling is accomplished with a separate buzzer circuit for each station to be signaled. The buzzers are operated by keys located at the various stations. The visual signal is a steadily lighted lamp under the intercom button at all the stations that have access to the line. As with dial intercom, the manual intercom line is not connected to any central office, PBX, or other external line.

Two types of mountings have been developed for the new plug-in units—factory-wired packages called Key Service Units (KSUs); and 23-inch mounting panels, also pre-wired for ‘packages’ of services, but generally used for larger installations. These mountings are identified by numbers in the 500s.

The 501 and 502 KSUs are identical except that connections to the 501 are made with “quick-clip” terminal blocks, while the 502 includes a cable with connectors on the free end. This design controls up to six lines. The connectors for the circuit boards are wired for either the 400 or 401 KTU, so the service package can be any combination of central office, PBX, and manual intercom lines—or six lines of any one kind.

Each KSU also contains an interrupter—an electric motor which drives cam-operated contacts that control the timing of the flash, wink and ringing signals. Further, the wiring harness includes the necessary wiring for adding a dial intercom system to the installation.

Two more lines can be added to a 501 or 502

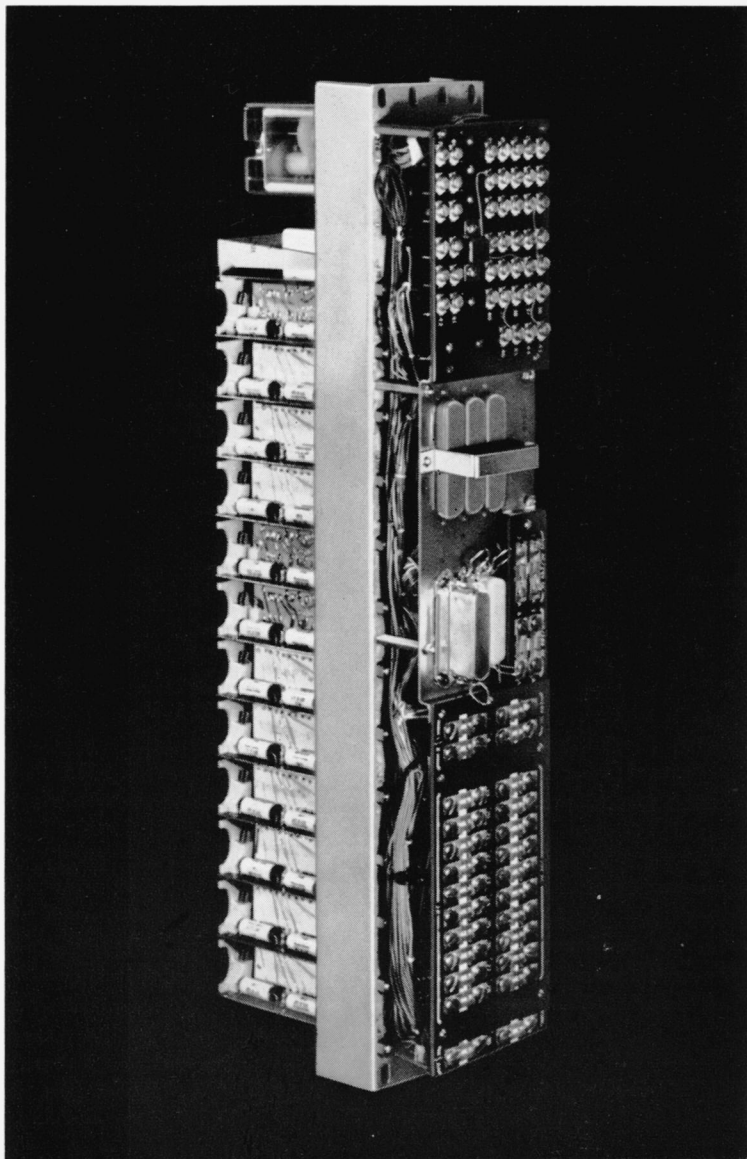


The 501 KSU, placed on a customer’s premises, furnishes key service for up to six lines in any mixture of central-office, PBX, and intercom lines. Circuit cards and equipment assemblies are readily changed to change service features and number of lines.

KSU by installing a special adapter unit, the 259 KTU. The 259 KTU is nothing but a receptacle for two plug-in cards, with mounting hardware, and must be wired into the installation on the job. The space can also be used for miscellaneous other equipment.

The 550 and 551 KSUs are identical except that the 551 includes a plug-in power supply. Either unit controls up to four lines and contains an interrupter to control the visual and audible signals. As in the 501, connections to the 550 and 551 KSUs are made through quick-clip terminal blocks.

The two mounting panels presently in use are the 583 and 584 panels. They are for installations in equipment rooms or other centralized locations where standard 23-inch racks are preferable to cabinets. The 584 panel has a capacity of 13 lines and space for mounting an interrupter. The 583 panel has a capacity of 15 lines and is usually used as an auxiliary to the 584. Synchronized signals for an installation of many lines require only one interrupter. The interrupter is installed on one panel, and a unit called the 412 KTU occupies the same location on other panels in the system. The 412, a plug-in board containing re-



The 584 panel controls up to 13 lines. It is designed for larger systems, where equipment will be mounted on a 23-inch rack in a telephone office or equipment room on the customer's premises.

lays and associated networks, is controlled by the interrupter. A new 511 KSU has recently been developed which will be a package using a modified panel to mount the plug-in units.

Accompanying the 1A2 key system, a new dial intercom system is now being developed at Bell Laboratories to replace the older 6A. The new system consists of four plug-in KTUs equipped with miniature relays, solid-state devices and associated components. The basic unit is the 407 KTU. It contains a counter and provides logic

and timing functions for the system. The audible signal is "single-spurt" ringing—a single ring about one second long—rather than the usual interrupted ringing, and the visual signal is a steadily lighted lamp at all stations whenever the line is being used. The 407 KTU makes up to 10 codes available (a code can be used to signal one or more stations). To expand the system, a 409 KTU can be plugged in, providing nine more lines.

The system includes one distinctive new feature. When a 410 KTU is used with a 407, the signal lamp at the called station flashes, while the lamps at all other stations light steadily to indicate the line is busy. To expand this type of system by nine lines, both a 409 and a 411 KTU are required. The 411 KTU also adds interrupted ringing to the system's service features. A special KTU, the 247B, must be used with the 1A2 system if the station sets have TOUCH-TONE® calling.

Another service feature of the 1A2 system, selective privacy, lets the customer at a station set temporarily disconnect a line from all other stations that have access to it. Each line that has the selective privacy feature must be equipped with a 405 KTU in addition to the 400 or 401. This service is more versatile than the manually-controlled cutoff or "exclusion" feature, and simplifies the automatic cutoff arrangements of the 1A1 system. Previously the service was offered for only one line per station, but the 405 KTU makes it available for any number of lines.

In addition to the usual hold signal (the winking lamp), it is often necessary to have a distinctive signal to indicate the priority of a call being held. This supplementary signal can be furnished in either of two ways: at a particular station, with the normal hold signal at all other stations; or at every station where the line appears. In the 1A2 system, the 406 KTU contains a generator that interrupts the lamp circuit 12 times per second, fluttering every lamp connected to the line, while the 408 KTU contains the detector circuit required to flutter the lamp only at the station where the line is put on hold. Two 408 KTUs can be used with each 406 in a system.

The 1A2 key telephone system is a substantial improvement over its predecessors. Not only does it make key telephone service more versatile and thus more valuable; it enables the Bell System to supply the service more economically.