



Telecenter® IV System Description

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General Information

Description

The Telecenter IV (TCIV) is a state-of-the-art microprocessor-controlled, centralized communication system designed for organizations with high volumes of internal communications. It can also be interconnected to the public telephone network.

The TCIV meets the needs of institutional and professional organizations for integrated internal communications and minimal telecommunication costs. It accomplishes this through hardware and software features that can be customized for:

- Interconnect
- Paging

- Speaker Intercom
- Call-Annunciation
- Time Signals and Alarms
- Telephone Communications

Purpose of this Manual

This manual provides an overview of the features, specifications, and basic operation of the Telecenter IV. The more technical aspects of system planning, design, installation, programming, testing, and trouble-shooting, are discussed in the other manuals that comprise KI-1435.

System Features

Interconnect

An interconnected TCIV provides smooth, simple handling of incoming and outgoing calls using up to eleven Central Office (CO) or PBX trunks. Interconnect trunks and TCIV lines may be configured in a wide variety of ways:

1. Dialing prefixes and area codes can be restricted to control costs.
2. Incoming- or outgoing-only calling can be implemented to keep lines available for specific communication requirements.
3. Incoming trunks can be assigned to specific TCIV extensions.
4. Incoming calls can be programmed to go directly to an attendant or to revert to an attendant if the called number is busy.
5. Outside stations calling into the TCIV can be allowed access to any TCIV Intercom features.
6. A Rauland-Borg TC4400 Call Control Console can handle 200 calls per hour—this is six times the rate obtainable using a key phone as the operator Console.
7. Standard Key Systems can be connected in a variety of ways to meet an exceptionally broad array of customer requirements.

Intercom Features

The TCIV provides sixteen simultaneous two-way telecommunication paths (links) between standard tone-dialing phone lines. These lines allow the TCIV to serve up to 500 stations and handle 350 calls per hour.

Standard tone-dialing telephones, with or without displays, can be used for administrative functions. Depending upon the system configuration and user programming, administrative stations may:

- Complete calls through direct dialing.
- Transfer calls and establish conferences.
- Perform intercom and paging functions.
- Program system features (display phones only).

Call assistance is provided for stations equipped with non-dialing (staff) phones and speakers with call switches. Visual and audible signals designate each call-in as having either Normal or Emergency priority.

The telephone-to-speaker intercom is hands-free at the speaker end, allowing calls to be answered from anywhere within hearing range of the speaker. The two-way intercom is automatically switched by the telephone user's voice.

The automatic queuing of intercom calls ensures the efficient use of each intercom channel during busy periods.

A prioritized interface to sound and paging equipment allows administrative telephones to make normal and emergency announcements throughout the system or to a selected Zone. This interface can also be used for time signals, warning tones, and chimes.

System administration allows user programming of individual station numbers and their options and features. Options and features available to any stations are determined by the station's line type (Administrative, Staff, Interconnect, etc.).

Advanced diagnostic features can be implemented using either an on-site administrative station with an alphanumeric display or a computer connected to the TCIV. Connecting a modem to the TCIV will enable you to perform the diagnostics from a remote computer via a telephone line.

System Specifications

The following specifications are for a fully configured TCIV but do not include any auxiliary systems that may be installed with it to help meet an organization's communications requirements.

500 Stations (maximum): Each station may have (a) one telephone with or without dialing capability; (b) a telephone and a speaker; or (c) a speaker and call switches.

16 Communication Links: Any link can provide an audio connection between any set of two or more lines in the system. No more links can be added to the system.

11 Interconnect Trunks: Each trunk may be programmed so that its incoming calls (a) will ring an attendant's phone (AAD), (b) obtain TCIV dial-tone for access to TCIV administrative functions (DISA), (c) or, like a private line, will ring a specified TCIV station (DIL).

350 Calls-per-Hour Traffic Capacity: This rate is predicated on an average of 2 minutes and 10 seconds per call.

Phone Lines: Use standard tone-dialing phones with ringers for administrative stations, and dial-less phones for single-link staff applications. You can use dial-less phones for multi-link staff phones; however, you should use dial phones where the user wants the flexibility of reprogramming the station for administrative phones. Multi-link phones (staff and administrative) are electronically switched to establish communication on any link; all single-link phones use one dedicated line.

DTMF Receivers: Two devices capable of sending and

receiving the full range of dual-tone multi-frequency signals required for dialing phones, including:

- Continuous, non-standard dial tone.
- Four-beep "busy" signal.
- Single long-beep error and disallow signal.

Graphic Display Drivers: The two drivers send control pulses to optional graphic displays. Each driver can control a TM432 Graphics Annunciate Module. The GAM, in turn, can be connected to an external 7- to 30-VDC power supply and pass on 100 to 200 milliamps per line to 32 lights or LEDs on a graphic display board; the amount of current that the GAM can handle depends upon how many lamps are lit simultaneously.

Graphic Display Driver 1 shows call-ins, and Driver 2 shows lines in use. The displays may be programmed to show Emergency Call-ins only or Normal Call-ins when no Emergency Call-ins are present.

LCD and VFD Displays: LCDs (Liquid Crystal Displays) are built into display telephones, and VFDs (Vacuum Fluorescent Displays) are mounted on walls for viewing by multiple users.

Both displays show up to 16 alphanumeric characters and have an audible call-in annunciator.

Up to three displays may be wired in parallel to each driver, provided that their combined distance does not exceed 1,000 feet (for 22-AWG shielded wire).

The wall-mounted VFD displays need 120-VAC power. No local power is required for the LCD displays.

Power Supply: The TCIV's switching power supply is U.L.-listed (UL478). It provides 12-VDC, 5-Amp line power; 90-VRMS, 28-Hz ring voltage; and 3-VDC bias.

System Components

The table on the next page itemizes the basic and optional equipment for a TCIV. For an example of how these components may be installed, refer to the Telecenter IV Rack Layout on the page following the tables. Note that several components have been given

shorthand (mnemonic) descriptors (e.g., "LLM16" for "Line Link Module"). These are for the convenience of thought and discussion only; always use part numbers (e.g., "TC4150" for the "LLM") when placing orders or writing Rauland-Borg about the equipment.

The TC4001 Main Central Assembly consists of the following standard subassemblies:

Part No.	Mnemonic	Description
N.A.	N.A.	Power-Supply Subchassis
TC4410	CPU	Central Processing Unit
VC7166	MIO	Main Input/Output Module
TC4150	LLM16	Line-Link Module (16 lines and 16 links for all communications functions, especially administrative, multi-link, and trunk lines. The first five lines of the supplied LLM are dedicated to system functions.)
TC4160	VCM2	Voice-Controlled Module to support one intercom channel.

Optional equipment

Part No.	Mnemonic	Description
TC4110	SC25	Speaker Control Board: Relays for 25 speakers; connects to a switch panel.
TC4120	SCC25	Like SC25, but with stand-alone chassis and dress panel. It can also be used for single-link phones.
TC4140	LLM-EXP	Expansion chassis providing room for 5 LLM16s.
TC4150	LLM16	Same as the standard TC4150 in the TC4001. It installs in an expansion chassis (TC4140).
TC4160	VCM2	Same as the standard TC4160 in the TC4001, which has room for one more. Additional VCM2s can be installed in a VCM-EXP.
TC4165	VCM-EXP	Expansion chassis that holds up to four extra TC4160s.
TC4180	N.A.	Expansion chassis for five COA modules and five TC4181 Repeater amplifiers.
TC4171	COA	Central Office Adapter module for a CO or PBX trunk.
TC4181	N.A.	Repeater amplifier, to compensate for audio losses within the TCIV.
TC4200	VFD	Vacuum Fluorescent Display for mounting on a wall.

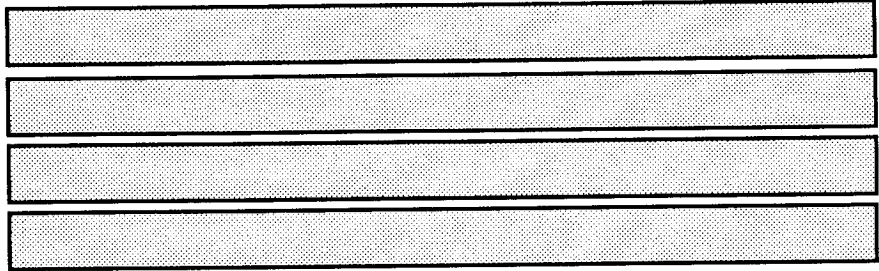
Part No.	Mnemonic	Description
TC4202	N.A.	Single-line administrative phone.
TC4211	LCD	Single-line administrative phone with display.
TC4250	LCD	Five-line administrative phone with display.
TC4300	N.A.	Slim-line-style administrative phone without tap button (not for office use).
TC4420	CIA	Console Interface Adapter: required for interfacing the TCIV with a TC4400 Console.
TC4400	CON	Call Control Console: provides the most efficient handling of incoming calls.
TM432	GAM	Graphics Annunciator Module: Drives graphic-display lamps; requires a DC power supply.
TMC433	N.A.	Expansion chassis for 14 TM432 modules.
MTG100	MTG	Multi-tone Generator: installs in the TC4001 to provide chimes, tones, etc.
CRT3	N.A.	Slim-line-style staff phone without a ringer.

Typical Telecenter IV Rack Layout

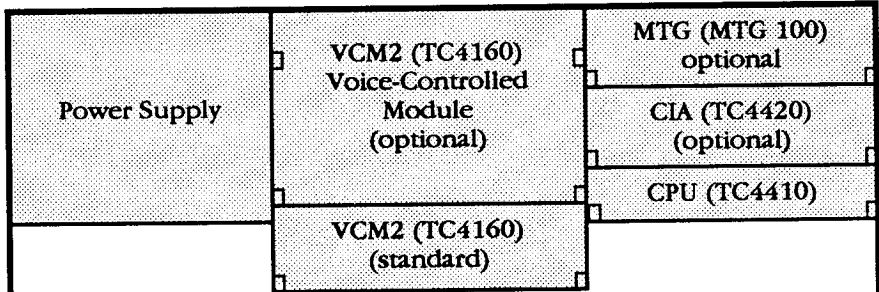
(Front View)

Speaker and Single-Link Phone Expansion Area (SC25s and SCC25s)

TC4110 (SC25s)
(with Switch Panels)
or
TC4120 (SCC25s)
(up to 20 Speaker Control
Boards may be installed for
speakers, and another 20 for
single-link phones.)



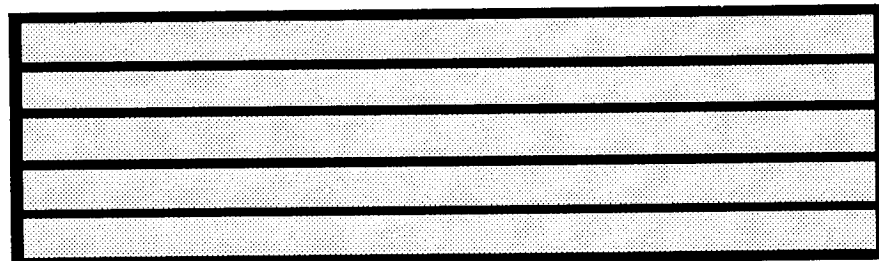
TC4001
with all standard and optional
modules.



MIO (VC7166) Main Input/Output Module

LLM6 (TC4150) 16 Line-- 16 Link Module

TC4140
and space for 5 LLM16s
(TC4150s).
(up to 6 TC4140 LLM expansion
chassis may be installed.)



Multi-Link Phone Expansion Area (LLM16s)

Functional Description of the System

Refer to the Telecenter IV Block Diagram at the back of this manual while reading the following discussion of the system operation.

CPU

The TC4410 Central Processing Unit assembly provides system control, timing, memory, and communication. It has an Intel 8085 microprocessor (CPU) operating at 4.9 MHz; the system's main program is contained in 56K of EPROM (electronically programmable read-only memory). Another 8K of memory is divided evenly between random access memory (RAM) work space and nonvolatile memory for user set-up data. The universal asynchronous receive and transmit device (UART) is for connecting the TCIV to a personal computer for diagnostic testing and programming.

8085

The microprocessor's main program monitors the status of remote equipment (phones, speakers, switches, and trunks), switches remote stations on and off, and changes links as required for communication functions.

Memory

Data can be read from and written into nonvolatile memory, where it is retained even when the system power is off. The memory is used to store user-supplied data, such as the attributes of each line used in the system (administrative, staff, and the various interconnect lines), options available to each line (available features, calling restrictions, speaker zone groupings, etc.), and extension dialing numbers (also called Architectural Numbers because they are frequently based on the room numbers). The main program uses these data to control system activity.

UART

The UART (universal asynchronous receive and transmit device) supports a serial interface with a personal computer. The PC can be connected directly or by a modem, and the UART may be programmed for baud rates from 300 to 9600.

This feature provides access to basic system "monitoring" functions via any communication program. Additionally, it can be used with an extensive diagnostic program, available from Rauland-Borg, for high-level control of the system.

High-Speed Bus

All input and output (I/O) from the CPU is handled by a high-speed, 34-conductor flat-cable bus. This runs to the VC7166 MIO and may also be connected directly to an optional TC4400 Call Control Console.

MIO

The VC7166 Main Input/Output Module is a large, multi-circuit board. Its eight-bit input and output ports

provide the interface between the CPU and various other system components, principally the TC4150 (LLM16) and the Speaker Control boards, TC4110 (SC25) and TC4120 (SCC25).

The main purpose of the MIO is to facilitate system operation via the two I/O Buses. Two medium-speed 26-conductor flat-cable buses connect the MIO to the expansion modules (one for the LLMs and one for the Speaker Control boards). These buses carry the following data:

LLM BUS

Outgoing Data:

- Expansion Circuit (0-511) Addresses
- Link number (0-15)
- Connect command
- Disconnect command

Incoming Data:

- Off-hook
- On-hook

SC BUS

Outgoing Data:

- Expansion Circuit (0-511) Addresses
- Relay-on command
- Relay-off command

Incoming Data:

- Ground signal on call-in line
- Resistor signal on call-in line

Hardware-addressing on the individual boards (DIP switches) gives each expansion circuit (0-511) a unique identity, allowing control over its functions by the CPU.

Other MIO functions include:

1. Generating and receiving tones via its two DTMF Registers.
2. Graphic Drivers (2), which may each drive graphic displays via one or more TM432 Graphic Annunciator Modules (GAMs).
3. Display Drivers (2) for the LCD and VFD displays (up to three displays per driver). The drivers supply the ASCII codes to the displays, which show call-ins (normal and emergency), last number dialed, user programming, and diagnostic functions.
4. Audio Relays (7) switch amplifier outputs (All-Page, Zone, or VCM) to designated Speaker Control Boards, and switch amplifier inputs to the MTG100 Multi-Tone Generator and other system audio sources.
5. Master Clock inputs to the MIO control the timing for time-tone signaling via the audio relays and optional external power amplifiers.

LLM16

Each TC4150 Line-Link Module supports 16 lines and 16 links (the same 16 links shared by all LLMs in the system). Each administrative phone, multi-link phone, and trunk line is connected to an LLM via a twisted pair at a particular set of terminals, each set corresponding to one of the 512 possible Physical Numbers in the system. LLMs provide the switching for up to sixteen simultaneous

talk-paths or links. Connecting two or more lines to a link places them in communication with one another.

The TC4001 Central Control Assembly comes with one LLM that will control up to 11 telephone lines. The first five Physical Numbers on this LLM are dedicated to system functions. Up to thirty-one LLMs can be added to the system, which can handle 512 lines (32×16). Each TC4140 Expander Chassis can hold five LLMs.

All LLMs are controlled via a 26-conductor flat cable from the MIO. Each LLM contains a DIP switch for address-programming, to enable the CPU to discriminate it from other LLMs in the system. The system's 16 links of audio signals are delivered to all LLMs by a single 34-conductor flat cable.

When a call is placed from an administrative phone, the CPU uses its Physical Number to connect the calling line to one of the DTMF receivers for dial-tone. When the caller dials a TCIV line or an outside trunk, the CPU uses this Architectural Number to connect the two lines together on one of the available 16 links.

The TCIV main program attends to switching operations by continuously scanning for active lines. A line becomes active when its call-in button is depressed or its phone is lifted off-hook. This active state is detected by the scan routine, and an active-list record is created. This record contains six fields that describe the state of the line, including its Physical Number, the process the line is currently in, and the type of service being requested. The CPU uses this information to provide the service requested.

SC25/SCC25

The TC4110 and TC4120 Speaker Control Boards are used only in Telecenter IV systems that have speakers or single-link staff phones. Each SC25 or SCC25 supports up to 25 speakers and provides relay-switching to allow:

- Intercom communication with speakers or single-link staff phones.
- Zone-paging and timed signals to a group of speakers by switching their associated lines to the appropriate intercom channel.
- Paging or alarm tones to all speakers by switching all lines simultaneously to the line associated with an auxiliary system.

The single Voice-Controlled Module (VCM2) included in the standard system can serve all of the speakers and single-link phones in the system.

Adding VCM2s—up to one per Speaker-Control Board—can allow more than one intercom activity to take place at the same time, provided that different Speaker-Control Boards are involved.

Like the LLM, each SC25 or SCC25 has a DIP switch for address-programming so that the CPU can identify it. The CPU uses the address to detect the status of any call-in line or to control relay switching. One DIP position differentiates SC boards used for single-link staff phones from those used for speakers.

Calling in from a speaker station requires a call-in switch of the Normal or Emergency type. Each type of switch provides an easily distinguishable signal to the CPU, which then signals the call-in and its type to the appropriate stations. Programming and hardware variables make this feature very flexible.

When a speaker relay is activated, the VCM2 provides hands-free speaker-to-telephone communication through voice-operated switching. When the telephone user is quiet, the speaker picks up room sounds and transmits them to the telephone. When the telephone user talks, the VCM2 directs the audio from the phone to the speaker. The VCM2 sends a supervisory beep to the speaker to provide notification when the area is being monitored. A Privacy switch can prevent the calling phone from monitoring room sounds. The switch must be set to "Normal" to enable the speaker to send audio to the caller. Regardless of the position of the Normal/Privacy switch, the caller's voice will be heard through the speaker.

If a staff phone is installed with a speaker, picking up the phone will automatically switch ongoing communications from the speaker to the phone.

Each SC25 is designed to be installed on the back of a switch panel. The panel provides a mounting location and switches the speakers to different channels for Director[®] Series functions (e.g., program distribution and intercom via a Master Control Panel). The following Rauland-Borg panels can be used:

The SW25 Three-Position Switch Bank has 25 three-position switches that toggle between the "Off" Bus and Channels "A" and "C."

The SWT425 Four-Position Switch Bank includes all the features of the SW25 plus Channel "B."

The SCC25 is functionally the same as the SC25, but mounts in the TCIV via a stand-alone chassis and dress panel. The SCC25 is normally used for single-link staff phones but can also be used for speakers when no Director Series Control Panels are used.

VCM2

The TC4160 VCM2 is a voice-controlled 12-watt amplifier providing intercom communication between a speaker and an LLM line. One LLM line is required per VCM2, and a VCM2 is required for each intercom channel. Only one intercom channel may be implemented on an individual Speaker-Control Board, and a VCM2 may be used by only one caller at a time.

When a phone dials a speaker, the TCIV uses the Architectural Number dialed to determine the Physical Number of the desired speaker and the location of its Speaker-Control Board. It then determines which VCM2 serves that board and connects it to the caller's link.

When the speaker connection is made (relay on), the VCM2 automatically begins sending a supervisory beep every twelve seconds. If the Privacy switch is not engaged, the caller will be able to listen to the room. If a staff phone associated with the speaker is lifted off-hook, this will cut the VCM2 out of the circuit and switch the communication path from the speaker to the phone.

The TC4001 comes equipped with one VCM2 and has room for a second one. Up to twenty-one VCM2s may be installed with TC4165 expander chassis, which can hold four VCM2s apiece. Multiple VCM2s usually require additional DC power supplies.

CIA (Interface for TC4400 Console)

The TC4420 Console Interface Assembly connects to the high-speed CPU flat cable to provide two-way buffering and FIFO (first-in, first-out) serial communication at

TCIV System Description

1200 baud between a TC4400 Call Control Console and the main system. This allows the Call Control Console to communicate directly with any internal line or interconnected trunk.

CON

The TC4400 Call Control Console is recommended for attendants who handle many calls, especially from outside lines. The Console uses only one LLM line. It has dedicated keys for transfer, hold, page, and intercom functions, plus 20 keys that can be programmed for (1) central-office trunks, (2) Telecenter IV internal or operator lines, and (3) direct dialing and monitoring of selected lines.

Each programmable key has two LED indicators: Red to indicate that the line has a call on hold, is waiting to be answered, or is connected to the Console; and Green to show that the related line is ringing or in use without involving the Console.

A built-in 20-character vacuum fluorescent display provides alphanumeric information as shown here and described in the following paragraph.

321_375____:383 ---

Counting from the left, the first 16 digits show the standard TCIV display information: digits 1 through 12 show Architectural Numbers of stations waiting to be answered (321 and 375); digit 13 is always a colon; and digits 14 through 16 show the last number dialed by the Console (383).

Digits 17-20 are unique to the Console. They show prompts to promote operator efficiency and effectiveness (e.g., dashes indicate that the Console is waiting for input).

The manual for the Call Control Console has complete information on its functions and operation.

COA

The TC4171 Central Office Adapter provides the FCC- and DOC-approved interconnect between the TCIV and the public telephone network. One COA is required for each trunk line (Central Office or PBX).

COAs accept ring-signal voltage from the outside line and convert it to the loop current required by the TCIV. Compatibility with any line configuration (loop-start and ground-start) may be accomplished during installation.

Up to five COA modules and five repeater amplifiers (see the following subsection) can be accommodated by a TC4180 chassis.

Repeater Amplifiers

The TC4181 Repeater Amplifier boosts incoming and outgoing audio by 6.5 decibels. This offsets the losses that

occur inside the Telecenter system. These losses can cause reduced audio levels on interconnected lines and, in some cases, dialing problems. For these reasons, Rauland highly recommends the use of a repeater amplifier with every COA Module. The Canadian Standards Association (CSA) requires repeater amplifiers in Canadian installations. The CSA-approved R-TEC VFR1050 (list 2) can be obtained locally.

VFD

The TC4200 Vacuum Fluorescent Display provides the same sixteen-digit display as standard TCIV display phones. It is designed for wall-mounting. Its large characters may be comfortably viewed from twenty feet away. The VFD may be surface- or flush-mounted in an appropriate back-box (not included), and it requires a separate 120-VAC power source.

MTG

The MTG100 Multi-Tone Generator is an optional module that generates tones for standard and emergency signaling via the Zone and All-Page functions. Available tones are: steady-tone, chime, interrupted-tone, and European police siren. The MTG plugs into a dedicated slot in the TC4001 Main Control Assembly.

GAM

The TM432 Graphics Annunciator Module provides lamp-drive signals for a board that graphically depicts system activities. A graphic display board gives monitoring personnel an immediate picture of what's happening and thus enables them to take timely action, such as calling the indicated station, turning on a camera in the area indicated, unlocking a door, etc. A 34-conductor flat cable from each GAM module provides thirty-two drive signals, each representing an individual station in the TCIV.

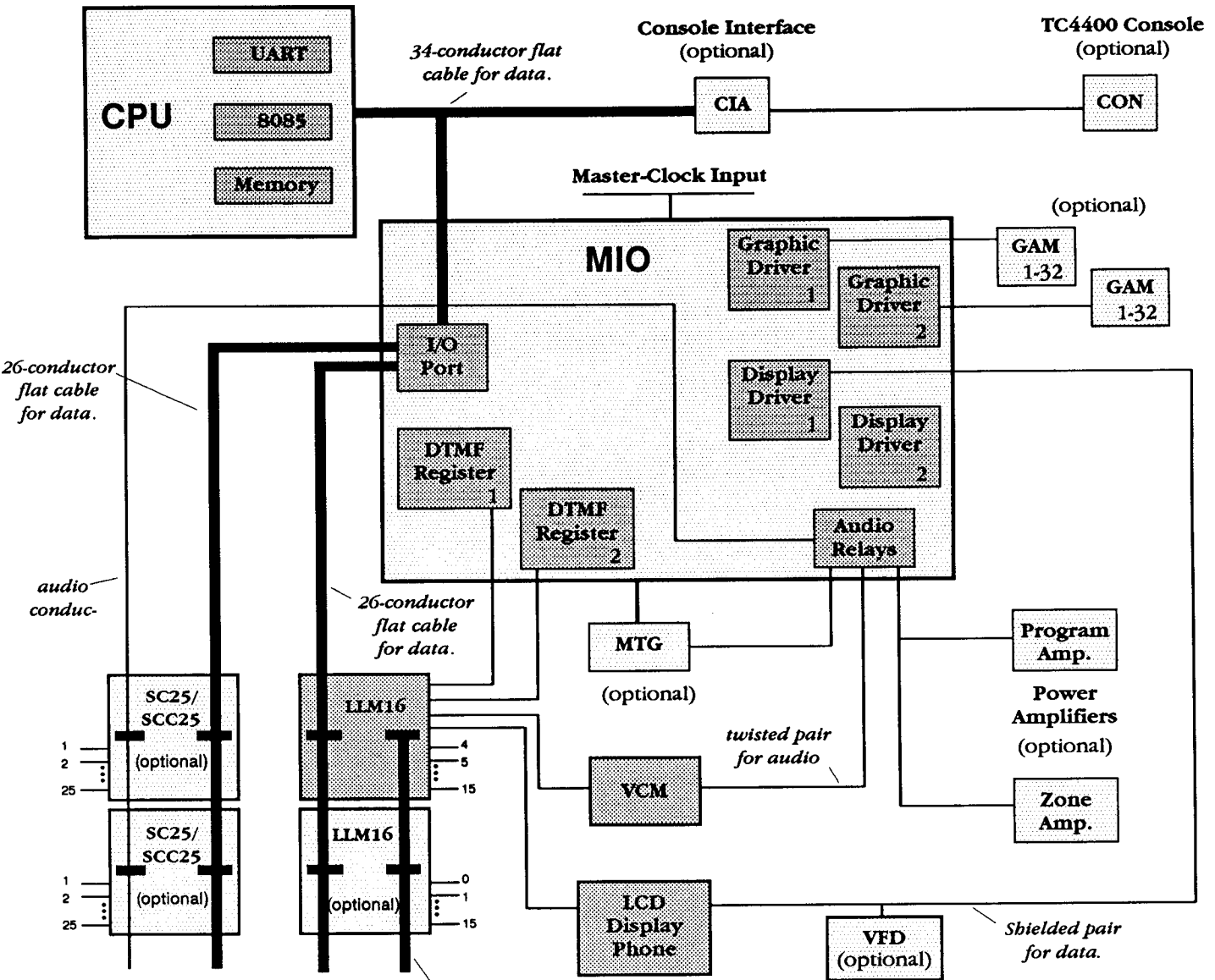
The TM432 GAMs may be installed in a remote graphics panel near the point of use or mounted in a TMC433 chassis. Because GAMs must use a common timing pulse, which can be altered as it travels, all GAMs must be located close together. A set of TM432s require only a single shielded pair from the main system and a local power supply.

Display Drivers

The two display drivers (GR1 and GR2) provide buffered outputs that can be used immediately. Two additional drivers are not supported with hardware, but they may be configured for use in special situations with the assistance of the Rauland-Borg Sales Engineering staff. In addition, a pulse generator may be installed on the output of a display driver to flash lamps.

The display drivers are software-programmable. GR1 may be used to indicate call-in signals, and GR2 may indicate which lines are in use. Additionally, the system may be programmed to show which lines are in communication with a separate small group of administrative phones.

Telecenter IV Block Diagram



Speaker Control Boards go to:

Speakers and Call-in Switches (SC25 or SCC25)
Ground: Normal
Resistor: Emergency

Single-Link Staff Phones (SCC25 only)

LLM16s go to:

Multi-link phones (admin. and staff)
 COA lines
 VCM boards

Note: Do not connect both speakers and phones to the same SCC25 board.

Mnemonic	Rauland Model No.
CIA	TC4420
CON	TC4400
CPU	TC4410*
GAM	TM432
LCD	TC4211/TC4250
LLM	TC4150*
MIO	VC7166*
MTG	MTG100
SC/SCC	TC4110/TC4120
VCM	TC4160*
VFD	TC4200

* Included in TC4001