



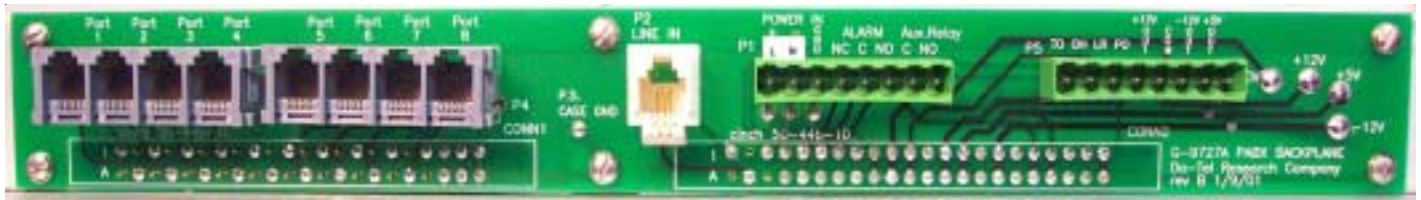
INSTRUCTION INFORMATION PROGRAMMABLE AUDIO LINE SWITCH G-9420A



GENERAL DESCRIPTION

The Programmable Audio Line Switch (PALS), model G-9420A, allows the customer to access devices within the substation from a single telephone communications line with only one call to the station. Once the G-9420A has answered, a window of time opens to allow direction of the call to one of the eight ports. If the call is not directed using DTMF tones, the G-9420A defaults to and rings port 1 after approximately 10 seconds. When communication to a port is complete, the user may redirect the call to another port once that device has gone on-hook. Port 1 is typically used for the handset in the station. A station emergency requiring use of this handset disconnects all other ports when port 1, or the handset, goes off-hook.

FIGURE 1



INSTALLATION

POWER CONNECTIONS:

The top of the case is labeled to show what system voltage the PALS is configured to operate on. Note that the 125Vdc unit operates on both 125Vdc and 115Vac. The power input is wired with the "+" or "L" of ac into the "+" input on connector P1 terminal 1. The "-" or "N" of ac connects to the "-" input at P1 terminal 2. The chassis ground connection at P1 terminal 3, is very important for the protective circuitry of the PALS; therefore, connect it to a very good ground.

TELEPHONE CONNECTIONS:

All telephone lines are terminated on a 2-wire, RJ-11 connector. If a 4-wire plug is used, the middle pair of contacts, usually red and green wires, is used by the PALS for communication. The LINE IN jack is for connecting the PALS to the line entering the building or station from the telephone company. The other 8 RJ-11 jacks connect the PALS to the devices in the station. Port 1 is the recommended port for the local station telephone since it may be programmed to interrupt all other ports.

AUXILIARY CONNECTIONS:

The G-9420A is provided with an alarm relay output at P1 terminals 4, 5 and 6. This relay contact toggles when the power is turned "OFF" on the unit or the microcontroller fails to "run". This relay follows the green "ON" LED on the front panel. When "ON" and operating normally, the relay contacts are closed from terminal 5 to 6 and open when power is lost.

Phoenix connector P5 makes available various high to low voltage levels. The

transistor collectors are controlled to provide the functions below under the P5 heading also refer to figure 1. The power supply potentials of +/-12V, 5Vdc, and signal ground are also provided on P5. The terminal numbers and their uses are listed below.

P5

| | | |
|---|---------------|--|
| 1 | TO | "Terminal On" 5V to ground (ground for ON) |
| 2 | OH | "Off Hook" 5V to ground (ground for OFF HOOK) |
| 3 | LR | "Local Ring" 5V to ground (ground for Port Ring) |
| 4 | PO | "Port Out" supplies a ground for Port Selection (collector output). 12V to ground. |
| 5 | +12V | |
| 6 | Signal ground | |
| 7 | -12V | |
| 8 | +5V | |

INDICATORS:

The G-9420A PALS provides LED indicators to help the user know it's operational condition and to diagnose any problems (see Table 1).

If port 1 yellow LED flashes on power up, an error has been detected in the time

clock for the DTMF decoder. If the port 7 yellow LED flashes, the NVRAM memory space is not available. Note also that the red RING INDICATION LED is merely a flash since the G-9420A answers immediately.

MOUNTING:

The unit is a 19" flat rack.

TABLE 1

| LED LABEL | COLOR | DESCRIPTION | NORMAL STATE |
|---------------------|--------|---|--|
| RING Indication OFF | Red | Indicates when an incoming ring signal is being applied to the G-9420. | |
| OFF HOOK | Yellow | Indicates when the G-9420 has answered and gone off hook. Will go out once port device goes off hook. | OFF, only ON when G-9420 holds the line. |
| LOCAL RING | Red | Indicates when a port is being rung. | OFF |
| ON | Green | Indicates when power is on and CPU is running. | ON |
| PORT 1 | Yellow | Indicates when port 1 is available or is off hook. | ON - available or off hook. |
| PORT 2-8 | Yellow | Indicates when a corresponding port is available or off-hook. | ON - available or off-hook. |

**APPLICATION NOTE
FOR USING TWO G-9420A PALS
TO ACCESS UP TO 15 AUDIO PORTS**

GENERAL

This application note encompasses how to apply the Da-Tel G-9420A Programmable Audio Line Switch to an application requiring more than 8 ports but not more than 15.

No special programming of the G-9420A is required to access the second G-9420A. The standard, factory configuration was used to test these hardware configurations.

HARDWARE

Figure 3 illustrates a typical application of two Da-Tel G-9420As. All that is required is the addition of devices to the ports to be accessed by the incoming telephone line.

The G-9420A is connected to the station battery according to the marking on the case for polarity. With the two G-9420As operating adjacent to each other, 5 Vdc and +/-12Vdc can be derived from the first G-9420A to power the second G-9420A. The switch on the first G-9420A controls the power for both units and the second G-9420A's switch is inactive. It is important for noise reduction to connect the ground terminal of the G-9420As to a good ground.

The telephone line into the site should connect to the RJ-11 connector marked INCOMING LINE on the backplane G-9727A. Port 1 of the G-9420A is typically a local handset for use by maintenance personnel. Port 8

is used to make connection to the second G-9420A, however, any port could be used. Ports 2 through 7 on the first G-9420A and ports 1 through 8 on the second G-9420A are available for dial-up devices. The diagram shows numbering for a 15 port setup.

PORT ACCESS

To access a port between 1 and 7 (2 for example), use the following sequence:

1(303)249-8919,,,2

where the number of commas is dependent on the telephone exchange connect time; three is a good start. To access a port between 8 and 15 (10 for example), use the following sequence:

1(303)249-8919,,,8,,,3

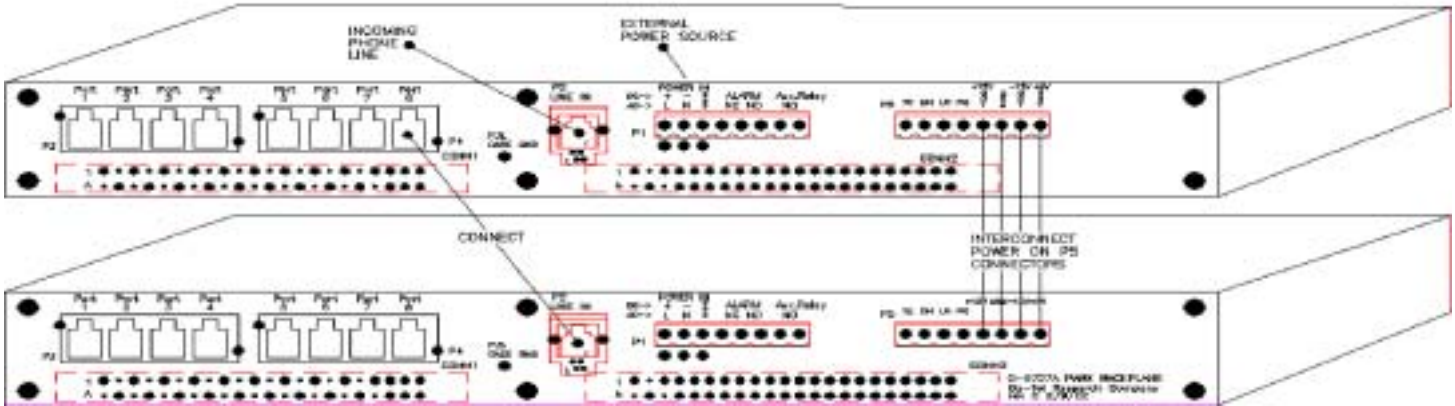


FIGURE 3

where this accesses port 10 (port 3 of the second G-9420A). The number of commas between the 8 and 3 is dependent on the connect time between the two units, 3 is sufficient. The 8 rings the second G-9420A and the 3 rings the port of interest on the daisy chained G-9420A.

TESTING AND CALIBRATION

GENERAL

The G-9420A Programmable Audio Line Switch (PALS) allows the user to dial into a station over a single telephone line and connect to multiple devices connected to its ports. The G-9420A has programmable features that also need checking.

Remove front cover plate held in place by two screws and observe test socket, two potentiometers, and one push and hold SLD switch.

***Note:** The following procedures are the factory test procedures already performed before shipment.

SETUP

Connect the dc input power such that the positive (+) is on P1 terminal 1 and the negative (-) is on terminal 2. Connect a ground to terminal 3, also.

A Teltone Line Simulator (TLS) is needed for telephone company simulation. Connect one port of the TLS to a touch-tone phone and the other port of the TLS to the LINE IN on the G-9420A. Multiple phones may be connected to the ports of the G-9420A to have devices to call in to.

TEST PROCEDURE

POWER-UP

Apply power and observe that the green ON LED is lit. The yellow PORTS AVAILABLE LEDs should also be on.

CALL PROGRESS (CP) TONES ADJUSTMENT (Line-In may or may not be disconnected)

Push and hold SLD push button switch to initiate the internal test tone and adjust the test tone level at TP3 to TP7 (signal ground) to +3.5 dBm with the trimmer POT labeled C.P., R11 (the left trimmer)..

DUAL TONE MULTIPLE FREQUENCY (DTMF) RECEIVE LEVEL ADJUSTMENT (LINE-In disconnected)

Push and hold SLD push button switch, this will initiate the internal test tone. Adjust the test tone level at TP2 to TP7 to -9 dBm with the trimmer POT labeled DTMF, R10 which is the right hand trimmer.

***Note:** If Telco "line in" is connected then adjustment of signal level between TP2 to 3 should be set to approximately -13.5 to -14 dBm.

FAX DETECT ADJUSTMENT

Line-In may or may not be connected, and do not push and hold SLD push button switch for this adjustment. Adjust R46 for 1100Hz at pin 5 or 6 of U26, then inject an 1100Hz -30dbm signal between TP1 and TP7 and observe pin 8 of U26 going low (from 5V to 0V).

***Note:** The top cover of the flat rack must be removed to make this adjustment. This adjustment has been made at the factory and should not have to be made again.

PORT RINGS (all ports)

With the TLS and handset connected, check all ports by dialing the G-9420A. Connect another phone to each port sequentially and redirect the calling to each port. Check to see that each corresponding port LED lights. Also, when the TLS is ringing, the RING INDICATION LED should light for each ring of the TLS. Then the OFF HOOK LED should light when the G-9420A goes off hook. When a port is ringing, the LOC RING LED should light.

PORT ANSWER (all ports)

With the TLS and handset connected, check that all ports answer by dialing the G-9420A. Connect another phone to each port sequentially and redirect the calling to each port. Check to see that each corresponding port LED lights and that the path is complete when the port phone is answered. Depressing keypad numbers is a good check to see if the audio path is good.

ROTARY (all ports)

With the TLS and handset connected, check all ports for rotary service by ringing the TLS phone from each port of the G-9420A. If each port rings the TLS phone, rotary option is working.

PRIORITY PORT INTERRUPT

With the TLS and handset connected, connect a phone to port 1 and another to port 2. With the priority port in the default state, dial port 2 of the G-9420A and answer with its phone. Ports 1 and 2 LEDs should be on. Pick up the port 1 phone and observe that the default time delay occurs before

control is given to port 1 (port 1 LED is only one lit at this time). Reprogram the G-9420A to disable priority port interrupt and rerun the test to verify that port 1 does not disconnect port 2 (*5720#). Reprogram to priority port interrupt enabled (*5721#).

INTERRUPT DELAY OPTION

Set the priority port interrupt delay code for a longer time, such as 10 seconds (*44100#), and rerun the previous test to verify the programming of the delay. When done, reset the delay to the default value (*44010#).

DIAL TONE DISCONNECT

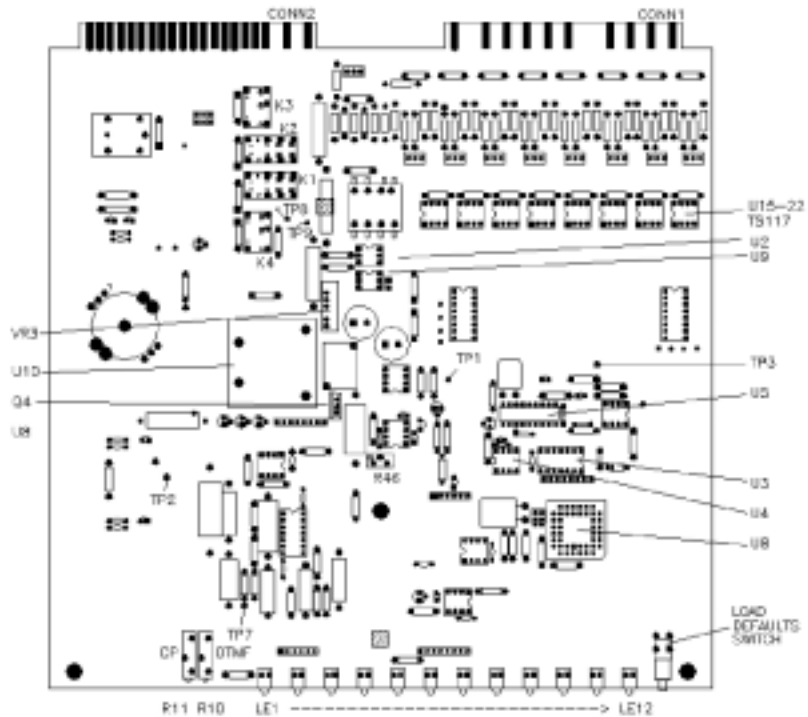
With the TLS and a handset connected, connect a phone to port 1. With the phone on-hook on port 1 and line in on-hook, momentarily depress the power button on the TLS to ON/RING. With the Dial Tone Detection option enabled, the RING INDICATION LED should illuminate and then go out. Reprogram the G-9420A to disable ring detection (*420#) and observe that the G-9420A remains off-hook until port one is answered or power-off. Reprogram back to enable dial tone detection (*421#).

BILLING DELAY OPTION

With the TLS and a handset connected, dial a port of the G-9420A. With the billing delay enabled, a two-second delay should be observed between when the G-9420A goes off-hook and when ring back tones occur in the TLS handset. Reprogram the G-9420A to disable the billing delay (*400#), and observe no delay. Reprogram back to the default of enabled billing delay (*401#).

RING BACKS

With the TLS and a handset connected, connect a phone to port 1. With the TLS phone, call the G-9420A and count the number of rings before the unit hangs up. This number should match the default. Reprogram the number of rings to 50 (*52150#) and call the G-9420A and verify the number of rings. Reset to the default (*52116#), default is 16 rings..



Simplified layout of the G-9420A
FIGURE 4

PORT 1 CUT-THROUGH

With the TLS and a handset connected, connect another phone to port 1. Power off the G-9420A and see that a call will go through to port 1.

Phone Drive Test

Attach 5, 1.0 bell equivalent phones to a port and ring that port. All phones should ring.

FCC TESTS

Apply 1500 Vrms, 60 Hz from T to R of the line in. This should not damage the G-9420A. Apply 1500 Vrms, 60 Hz from T and R to the chassis, with no damage to the G-9420A. Apply 100 Vrms, 60 Hz to T&R and T&R to chassis of all ports. No damage and no potential present at the line in port or another port should result.

Measure the line out noise level with all phones on-hook. This should be less than -60 dBm.

Measure the ring generator frequency.

Measure the ring generator frequency while ringing a port with one phone on it. Should be close to 20Hz and amplitude approximately +38 dBm rms.

THEORY OF OPERATION

An incoming call to the G-9420A PALS detects ringing voltage, U2, and signals the main processor, U8. The PALS answers immediately by going off-hook. Relay K3 is energized, the front panel LED, LE2, glows yellow and a 600 ohm load is placed across the LINE IN to draw loop current. The call-progress tone generator, U3, is controlled to send a double-beep and indicate to the caller that a window of steering opportunity is available. If a DTMF tone is sent, the DTMF decoder, U5, instructs the processor of the tone code sent and then closes the solid-state switch, TS117, that corresponds to that port and a second double-beep is initiated, closing steering window. At this point all the port LEDs extinguish except the port being called and the priority port if programmed to interrupt. The processor alternately places loop current using VR3 and K4 or ring voltage Q4 and U10 on the port, the red LED, LE3, local ring will flash on with a ring out to the port. If the device on the port goes off-hook during ringing, the ringing voltage collapse detector, U9, will command the ringing to cease immediately. If the device goes off-hook between rings, the TS117 will detect loop current flow and the connection

is made. Once a port is determined the processor connects the port to the line by using K1 and then releases K3 to allow the port device to hold the line off-hook. If multiple connections from one call are enabled, when the port device goes on-hook, the line is again placed off-hook by the PALS before the line is lost to no loop current being drawn. A double-beep is again sent to allow the caller to start the process over again, otherwise the PALS releases the line.

If a port device wishes to call out, it must go off-hook and draw loop current from the local voltage source placed on all the ports by K4 and K1. Since the port device has drawn loop current, the PALS lights its LED and the priority port LED if programmed. Also, the PALS connects the port device to the LINE IN using K1 such that the central office recognizes the off-hook. The port device then functions as normal.

Some other features are; if power is lost, K2 will de-energize and short the LINE IN to the port 1 connection allowing port one and outgoing connection to occur. The FAX tone detection circuit, U25 and U26, when a FAX machine normally sends its type 3 tones and, if programmed, the FAX tone will automatically route the call to the assigned port.

The G-9420A will hang up or go on-hook in four different ways. The G-9420A goes on-hook, if device attached to port 1-8 is a modem, upon loss of carrier tone between modems then port modem will exhibit a high resistive input impedance causing loop current to stop flowing, then port switching device TS117 will signal processor to have G-9420A to go back on-hook. The caller selects a port but the port device will not answer then the G-9420A will go back on-hook after a programmed amount of rings occur (default is 16 rings). If the G-9420A is programmed to detect dial tone, then during the steering window dial tone is detected, U4 will signal the processor to hang up the G-9420A. The G-9420A decodes a caller's key pad "#" symbol and it's DTMF tone if occurring during steering window time will be decoded and cause the G-9420A to go on-hook..

INTERFACING WITH PROJECT'S APPLICATION SOFTWARE

To communicate with the end device a personal computer (PC) equipped with a modem and the project's application software is required. Access requires the project's application software be configured with a command string. This command string consists of the destination device's phone number and G-9420A port number. Typically the application used to read the remote device allows the operator to enter and store a command string for each device. Future sessions simply require initiating the call from the operator's PC. A call initiated by the application, hands the command string to the which places the call to the end device. Depending upon the port device modem type the command string varies. The two modes are caller transparent and modem transparent. In caller transparent mode the G-9420A goes off-hook and quietly waits for the port number during the steering window time. If the steering window times out with out receiving a port selection number it will ring the default port. This mode most resembles dialing a handset thus not confusing the caller nor alerting an unauthorized caller that data devices can be accessed at this number. In modem transparent mode a secondary dial tone is generated by the G-9420A during the steering window time prompting automated port steering.

For caller transparent mode, the command string instructs the modem to repeatedly send the port number. An example would be "2496129,,4,,4,,4". 2496129 is the phone number of the station where the device is located, port 4 is the forth port of the G-9420A. The commas (2) instructs the modem to wait 0.5 seconds (0.25 each) and then send the port number 4, three times. The number of times to send the port number depends upon the telephone network and will vary from call to call. The saved command string should be structured for the worst case determined by trial and error.

For modem transparent mode, the command string is simpler to set up. An example would be "2496129W4". This instructs the modem to place the call and wait for a "secondary dial tone". When the G-9420A goes off-hook it sends to the calling station a secondary dial tone. The calling modem in the operator's PC detects this tone and completes the dialing string by sending the port number, 4. In either case once the modems are connected, communications are established between the operator's PC and the remote device.

PROGRAMMING

Table 2 lists all of the features that may be altered using the programming strings shown. The factory defaults are also shown and typically work for 99% of the installations used by our customers. Also, if errors are made in programming, sometimes the G-9420A will respond erratically. To reload the factory defaults, depress and hold the SLD switch, located on the front panel right hand side, cycle power switch off/on then release the SLD switch. The defaults have now been reloaded (SLD = switch; load defaults).

To program a string from Table 2, connect the G-9420A to either a telephone line or a telephone line simulator. Call the unit and when the first double-beep is heard, key in the command string using the telephone DTMF key pad ensuring that the * is the first character entered. When the command string is entered and then keying in a # (pound sign), the G-9420A will respond with a double-beep to indicate that it recognizes the string and has stored the new parameter. The programmer may load one or multiple command strings during the same steering window.

ZONE AND CODING DESCRIPTIONS

0 = None
1 = Ring Tone (440 and 480Hz)
2 = Low (350Hz)
3 = Mid (480Hz)
4 = High (620Hz)
5 = Dial Tone (350 and 440 Hz)
P = Port (1-8)
X = Seconds, Tones, Cycles, Enabled or default, number of rings, etc.

COMMAND STRING CODE DESCRIPTIONS

(DTMF Tones are initiated by the LINE IN telephone key pad)

" * " Enables or starts the ability to program a command string into the processor at the time of the steering window.

" # " The "#" sign (DTMF Tone Code) during the steering window will command the G-9420A to hang up or go back ON HOOK. Exception to this is after entering a command string the first "#" tone "sets" command into the processor and if followed by a second "#" tone, will place the G-9420A back ON HOOK.

SPECIFICATIONS

ENCLOSURE: 19" Rack Mount, 1U High, 10" Deep, aluminum

PANEL MOUNT: 8.85" x 11", 1/4" holes

WEIGHT: 4.5 lbs. Maximum

TEMPERATURE RANGE: -20° to +70°C, operating; -35° to +85°C, storage.

SUPPLY ISOLATION: 3500V.

DATA RATE: 14.4kBPS

ON-HOOK LINE IMPEDANCE:
>10K ohms.

OFF-HOOK LINE IMPEDANCE:
Approx. 600 ohms.

SIGNAL LOSS, Line-to-Port: less than 0.2dB

RINGER EQUIVALENCE: 1.0B

PORT RINGER CAPABILITY:
5.0B, minimum

FCC REGISTRATION NO.:
IDFUSA-22979-KX-T

POWER INPUT:
8W, max. at 48Vdc (38V to 63V)
10W, max., at 125Vdc (100V to 200V)
or 115Vac (85V to 135V)

POWER SUPPLY OPTIONS

15 Watt Power Supplies (please list # on order)

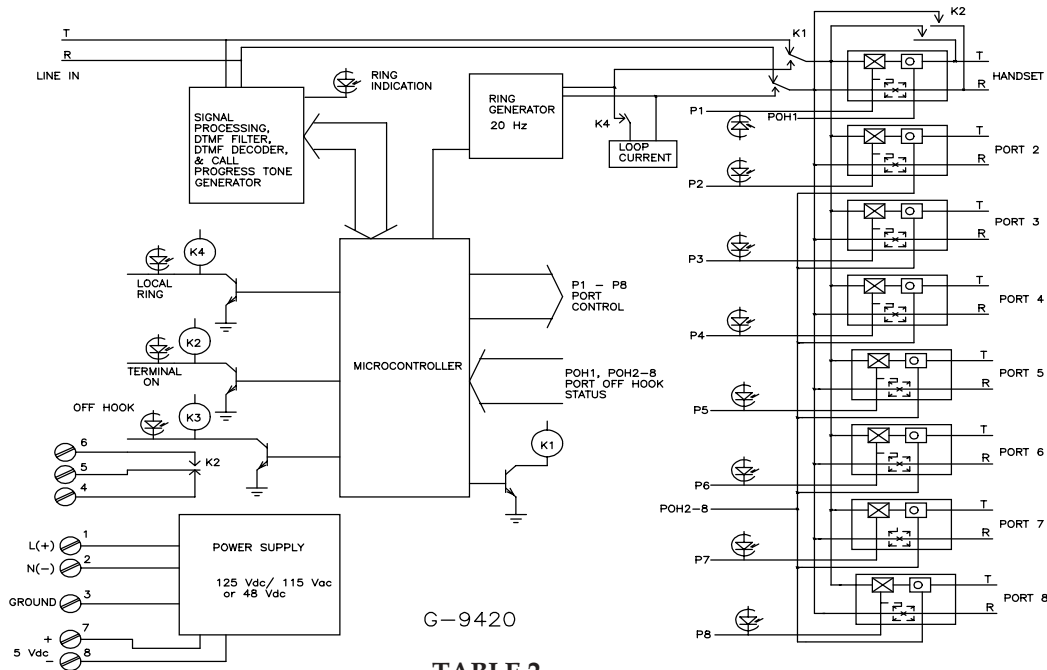
| STOCK NO. | INPUT | OUTPUT |
|-----------|------------------------|---------------------------|
| ACA-107 | 90-132Vac, 110-175Vdc | +/-12V @ .15A, +5V @ 1.8A |
| ACA-207 | 180-264Vac, 220-350Vdc | +/-12V @ .15A, +5V @ 1.8A |
| DCA-207 | 19-32Vdc | +/-12V @ .15A, +5V @ 1.8A |
| DCA307 | 38-63Vdc | +/-12V @ .15A, +5V @ 1.8A |

25 Watt Power Supplies (for accessory equipment, if needed)

| STOCK NO. | INPUT | OUTPUT |
|-----------|------------------------|---------------------------|
| ACB-107 | 90-132Vac, 110-175Vdc | +/-12V @ .5A, +5V @ 2.8 A |
| ACB-207 | 180-264Vac, 220-350Vdc | +/-12V @ .5A, +5V @ 2.8A |
| DCB-207 | 180-264Vac, 220-350Vdc | +/-12V @ .5A, +5V @ 2.8A |
| DCB-307 | 38-63Vdc | +/-12V @ .5A, +5V @ 2.8A |

* The above power supplies are manufactured by International Power Sources, Inc., 200 Butterfield Drive, Ashland, MA 01721, Tel (508)881-7434. Other brands must be less than 1.25" thick. Regulation must be +/-1% and ripple less than .5%.

FIGURE 5
Simplified block diagram of the G-9420A



G-9420

TABLE 2

| OPTIONS FOR EACH PORT | COMMAND STRING | DEFAULT (factory settings) |
|---|---|--------------------------------------|
| Ring On Time Sets the ring on cadence in hundredths of seconds. | *50PXXX# P = 1-8, XXX = 001-999 | XXX = 010 (1 second) |
| Ring Off Time Sets the ring off cadence in hundredths of seconds. | *51PXXX# P = 1-8, XXX = 001-999 | XXX = 030 (3 seconds) |
| Number of Rings Sets the number of rings before disconnecting. | *52PXX# P = 1-8, XX = 01-99 | XX = 16 (16 rings) |
| Tone During Ring On Time Sets the tone that the caller will hear during the Ring On Time. | *53PX# P = 1-8, X = 0-5 (See Tone Description) | X = 1 (Ring Tone) |
| Security Code Enables the requirement for the caller to enter a security code after the port code before access to the port is allowed. | *54PXXX# P = 1-8, XXX = 000-999 (000 disables the security feature) | XXX = 000 (Disabled) |
| Confirmation Signal Allows the user to enable/disable the Confirmation Signal audible when the port is selected. | *55PX# P = 1-8, X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |
| Connection Type Sets the port connection type. This allows for a port to become a Calling, Answer or Normal port. | *56PX# P = 2-8, X = 0-2 (0 = Normal, 1 = Answer, 2 = Calling) | X = 0 (Normal) |
| Port 1 Interrupt Control Allows the enabling or disabling of the ability for Port 1 interrupts. | *57PX# P = 2-8, X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |
| Continuation Port Sets the next port to ring after a connection completion of the current port. | *58PX# P = 1-8, X = 0, 1-8 (0 = Disabled) | X = 0 (Disabled) |

Table 2 continued . . .

| STEERING WINDOW OPTIONS | COMMAND STRING | DEFAULT |
|--|--|---|
| Steering Window Start Indication Enables/Disables the steering window start indication. | *30X# X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |
| Steering Window Tone Cycles Sets the number of tone cycles during the window before defaulting to Port 1. | *31XX# XX = 00-99 (0 = skip steering window) | XX = 03 (3 cycles) |
| Steering Window Tone Sets the audible tone during the Tone On time during the window. | *32X# X = 0-5 (See Tone Descriptions) | X = 1 (Ring Tone) |
| Steering Window Tone On Time Sets the Tone On time. | *33XXX# XXX = 000-999 | XXX = 010 (1 second) |
| Steering Window Tone Off Time Sets the Tone Off time. | *34XXX# XXX = 000-999 | XXX = 030 (3 seconds) |
| Multiple Connection Window Start Indication Enables/Disables the steering window start indication. | *35X# X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |
| Multiple Connection Tone Cycles Sets the number of tone cycles for the multiple connection window. ("**"Enable this command first for all multiple connection commands) | *36XX# XX = 00-99 | XX = 00 (Disabled) (0 = Disabled) |
| Multiple Connection Tone Sets the audible tone during the Tone On time during the multiple connection window. | *37X# X = 0-5 (See Tone Descriptions) | X = 5 (Dial Tone) |
| Multiple Connection Tone On Time Sets the Tone On time. | *38XXX# XXX = 000-999 | XXX = 100 (10 seconds) |
| Multiple Tone Off Time Sets the Tone Off time. | *39XXX# XXX = 000-999 | XXX = 000 (0 seconds) |

| MISCELLANEOUS OPTIONS | COMMAND STRING | DEFAULT (factory settings) |
|---|---|-------------------------------|
| Billing Delay Enables/Disables the 2 second billing delay. | *40X# X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |
| Answer Termination Delay Sets the PABX on-hook delay when an answered call is terminated. | *41XXX# XXX = 000-999 0-99.9 Seconds | XXX = 050 (5 seconds) |
| Dial Tone Detection Enables/Disables Dial Tone detection. | *42X# X = 0,1 (0 = Disabled, 1 = Enabled) | X = 1 (Enabled) |



DA-TEL RESEARCH COMPANY, INC.
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For more information about Da-Tel Research Company and our products, contact:

DA-TEL RESEARCH COMPANY, INC.
P.O. Box 1206, Montrose, CO 81402
Phone: (970) 249-6129 Toll-Free: 800-324-8388 Fax: (970) 249-8919
e-mail: info@da-telresearch.com or visit us at: www.da-telresearch.com

**Equipment and/or components purchased through Da-Tel but manufactured by other companies are covered under the warranties of those manufacturers.*

NOTICE

As of the date of this printing, the specifications for the G-9420 in this Instruction Information sheet apply to all G-9420 Programmable Audio Line Switch, except as indicated. Because all Da-Tel products are continually being refined and improved, these specifications are subject to change without notice.