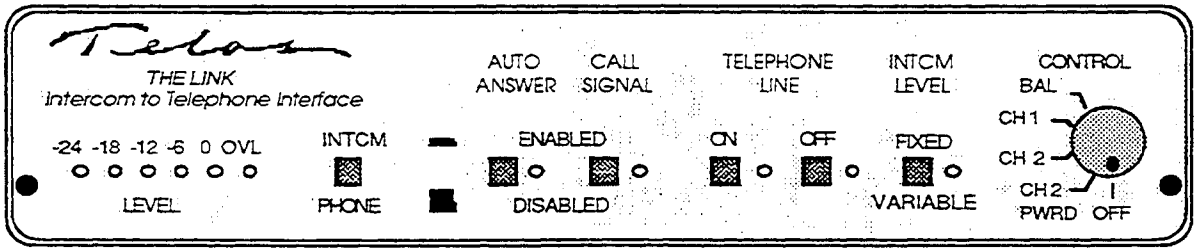
The LINK

Intercom-to-Telephone Interface

User's Manual



Telos SYSTEMS

Patent Notice

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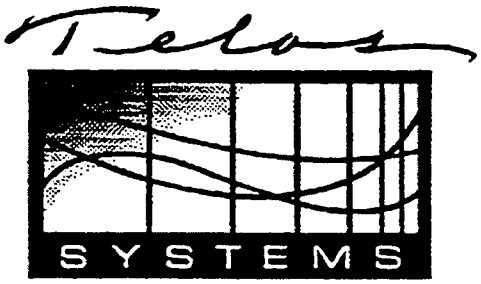

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User's Manual
The LINK Intercom-to-Telephone Interface

SECTION 1

INTRODUCTION

1.1 OVERVIEW

Introduction

We think the Link solves a common problem in a way that is simple and transparent to the user. However, the technology we've used is absolute state-of-the-art and represents the culmination of more than six years of our work in the digital telephone interface field.

In the past few years, we've been aware that some of our digital hybrids intended for on-air use had found their way into the intercom interface application for which the Link is intended. While users told us that the use of our equipment allowed significant improvement over earlier approaches, they also told us that we should make a box with specific application to intercom interface. They said it would be nice if everything were in one box. They told us about features they needed. We listened. We've done it. We trust you will like it.

Purpose

The Telos Link represents a state-of-the-art solution to problem of interconnecting production intercom systems with dial-up telephone lines. Because it uses adaptive digital hybrid technology, it allows such connections to be made without the usual gain and/or feedback problems while maintaining natural full-duplex operation.

A powerful digital processor is used to perform all audio processing functions:

- Digital auto nulling hybrids on both the telco and com paths
- Automatic Gain Control on both paths
- Smart gain switching to enhance hybrid performance
- A pitch shifter for further reduction of potential for feedback
- Call signal generation

This high-technology approach results in significantly improved communication capability compared to older techniques which relied upon multiple boxes and primitive manually adjusted analog hybrids.

Special Features

Although the internal technology is very complex, we have made the installation and operation of the unit quite simple. A number of features serve to assist in incorporating the interface into the usual intercom system.

- An interface for RTS, Clearcom, and other intercom systems is built-in. The XLR connector for intercom connection is configured in the same format as that used on standard belt packs. Thus, the unit may be connected simply as if it were a belt pack. A front panel switch selects intercom channels.

- A "wet" single channel operation option is selectable for applications where only one or two belt packs are required. In this mode, intended primarily for field truck use, the Link provides power to the belt packs.
- Metering is provided for both intercom and telco levels.

- An auto-answer function is built-in. When active, the auto-answer allows unattended operation. A loop current drop detector causes the unit to hang up when the call is discontinued from the far end.

- Intelligent automatic balance nulling and gain control result in no hassle operation. No adjustments are neccessary. Perfect performance is achieved every time without the trouble of set-up.

- A function to alert listeners that a call is ringing-in is standard. This is provided via the 20kHz "call light" signalling function when available in your intercom system or by audible tone signalling.

- Telephone connections are via standard modular jack and a loop-thru connection is provided for a phone set.

- The unit is fully remotable to allow incorporation into sophisticated systems.

- A digital high-pass filter is used to reduce hum and other low frequency interference. High frequency noise above the telephone frequency range is also attenuated.

• Unique to the Link is a special feedback reduction function using a pitch-shifting approach.

Operation

When a call is initially established, a brief *adaption period* provides an opportunity for the system to set-up to the telephone line and the intercom system impedances before the call goes on to the intercom listeners. The caller hears a "noisy tone" while the intercom listener hears a two-tone signal.

Adaption continues as the conversation proceeds, using voice as the driving signal.

The Hardware

Because the audio processing functions are performed in the digital domain, the hardware design of the Link is quite simple. The hardware merely serves to get the various signals into the digital domain where the digital processor does the work.

1.2 SPECIFICATIONS

System

True digital. Second generation Texas Instruments TMS320C25 processor. 8 kHz sampling rate. Internal digital input and output gain processing, filtering.

Trans-hybrid Loss

>40 dB with pink noise or voice as test input.

Send Level to Phone Line

-10 dBm average level. Maintained by internal digital AGC.

Frequency Response (caller to intercom)

200 - 3400 Hz +–1 dB.

Noise and Distortion (caller to intercom)

Distortion: <.5% THD + N. 1 kHz; caller levels from -48 to -8 dBm.
Signal-to-Noise: >60 dB. Referred to -18 dBm phone level. >72 dB ref to 0 dBm phone line level.

Monitor Audio Output

XLR male connector. Active differential. Typical output level 0dBm. Will drive 600Ω.

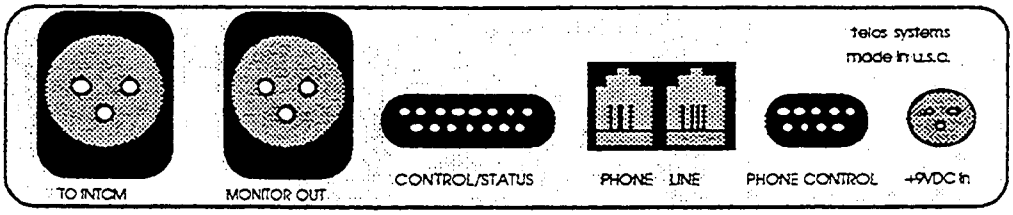
Intercom Interface

RTS style configuration. Three-pin XLR female connector. Selectable via front panel switch for channel 1, channel 2, or balanced mode operation. Intercom send and receive level approximately 0dBv in HI mode; -10dBv in LO mode.

Channel 2/wet mode: provides 18v at up to 100ma to power one or two standard belt packs.

SECTION 2

INSTALLATION



Rear Panel

2.1 CONNECTION TO THE TELEPHONE LINE

LINE and PHONE Modular Jacks

Phone connections are made via the standard modular jacks on the rear panel.

The **LINE** jack should be connected to the incoming central office telephone line using a modular cord (provided).

The **PHONE** jack is a loop-through connection which passes the phone line through when the hybrid is not active. It is normally used for connection of a desk set phone.

Both modular jacks use the center two pins (red & green) for the audio connection. The telephone connections are also available on the **PHONE CONTROL** connector.

"A lead" Output

The "A lead" output provides a relay contact closure which may be used for any desired purpose. Typical application would be to "hold up" the line when user-devised connection schemes to multi-line phones are implemented.

The outer two pins (black & yellow) of both modular jacks provide the A lead output. This output is available on the **PHONE CONTROL** connector as well.

2.2 CONNECTION TO THE INTERCOM SYSTEM

The TO INTERCOM female XLR provides direct connection to the intercom system. It is configured to emulate a standard intercom station. It may be connected to the intercom system in parallel with other stations.

Please note that the **MONITOR** *XLR connector is* not *for intercom loop thru.*

The TO INTERCOM connector pins are configured as follows:

- *CONTROL Switch set to* **CH1** *or* **CH2***:*

  Pin 1 - Ground
  Pin 2 - Channel 1 Audio
  Pin 3 - Channel 2 Audio

Power is not provided by the LINK; however, the intercom line may have power present, of course.

- *CONTROL Switch set to* **BAL***:*

  Pin 1 - Ground
  Pin 2 - Balanced Intercom Audio Hi
  Pin 3 - Balanced Intercom Audio Lo

Power is not provided by the LINK; however, the intercom line may have power present.

- *CONTROL Switch set to* **CH2/PWRD***:*

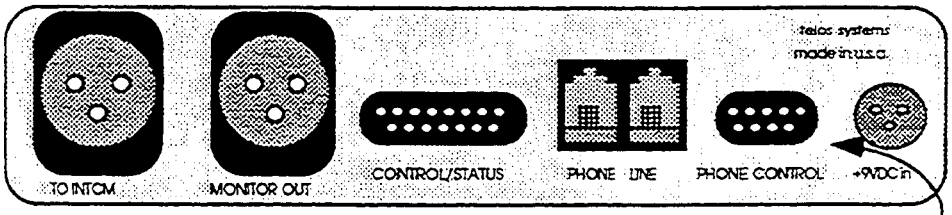
  Pin 1 - Ground
  Pin 2 - 18v DC power
  Pin 3 - Channel 2 Audio with 200Ω load resistor

Power is provided by the Link on intercom channel 1. Since the Link power supply is not the "constant impedance source" type, channel 1 may not be used for audio. Only channel 2 is available for audio. No adapter cable is required as the 200Ω load resistor for the audio channel is provided by the Link.

2.3 REMOTE CONTROL

Access to Phone Connections via the DB9 Phone Control Connector

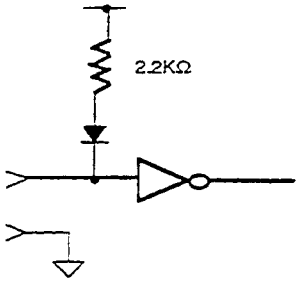
The PHONE CONTROL female DB9-type connector provides parallel access to the telephone line conections, as well as external ON/OFF control.



"PHONE CONTROL" Female DB9 Connector (J4)	
5	Phone Line "Tip" (parallels LINE mod jack)
9	Phone Line "Ring" (parallels LINE mod jack)
4	Phone set "TIP" (parallels PHONE mod jack)
3	Phone set "RING" (parallels PHONE mod jack)
2	"A Lead" output (parallels both mod jacks)
8	"A Lead" output (parallels both mod jacks)
1	Momentary "ON" input closure to ground
7	Momentary "OFF" input closure to ground
6	Ground

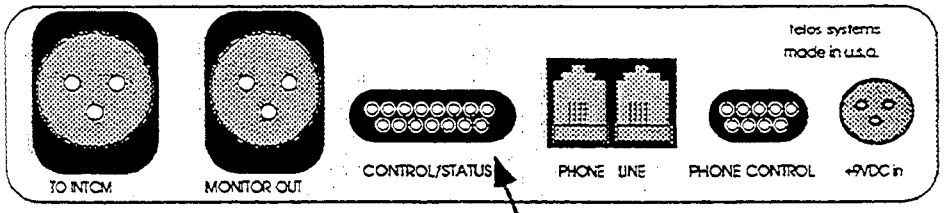
Remote OFF/ON

The momentary OFF and ON inputs (J4-7, J4-1) require a momentary closure to ground. A continuous ON/OFF control input is available on the CONTROL/STATUS DB15 connector and is described below. These inputs are buffered and pulled up with a 2.2 KΩ resistor through a diode. Thus, they may be connected directly to switches or may be driven by an open collector or TTL-compatible logic output. They may also be sourced by up to 30vdc if neccessary. The input circuit is shown below.



Internal Link circuit for control inputs

Control and Audio Connections via the DB15 Control/Status Connector



"CONTROL/STATUS" Female DB15 Connector (J2)
1 "AUTO-ANSWER" status OUT (active low) 9 "CALL" status OUT (active low) 2 "OFF" status OUT (active low) 10 "ON" status OUT (active low)
3 Momentary "ON" OUT (low going pulse) 11 Momentary "OFF" OUT (low going pulse)
7 "ON/OFF" INPUT ("ON"= low, "OFF"=high)
8 "TELOS" 4-wire com IN (unbalanced audio IN) 15 "TELOS" 4-wire com OUT (unbalanced audio OUT)
4 +5VDC 12 +5VDC 5 Ground 6 Ground 13 Ground 14 N/C

Status & control outputs

The status outputs (J2-1,2,9,10) are open collector transistors which make connection to ground when active. Maximum output current is 300ma. The Link also provides two open collector outputs

(J2-3,11) that can be used to control other external devices that require momentary closures to ground.

Continuous ON/OFF control input

The ON/OFF input (J2-7) is designed for a *maintained* high(off) or low(on) level. The ON/OFF input is active low and is referenced to ground. A low-going edge causes the Link to switch on, while a high-going transition will cause the Link to switch off. Since this input is edge-detected, the momentary ON and OFF inputs will be active even when this input is being held high or low. The internal circuit is the same as for the momentary ON/OFF inputs.

Intercom 4-wire input/output

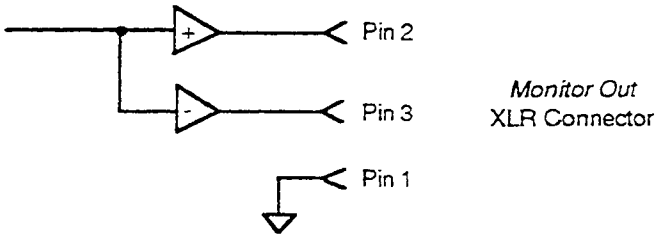
The **4-wire input/output** (J2-8,15) connections allow use of 4-wire intercom systems. In a 4-wire system, the send and receive signals each have a separate connection path; thus, the Bilateral Current Source 2-to-4 wire interface section which normally provides interface to the intercom line is not neccessary. These 4-wire ports bypass the Bilateral Current Source 2-to-4 wire interface section inside the Link. (See schematics and block diagram for details)

2.4 MONITOR OUTPUT

The **MONITOR OUT** male XLR connector provides a combined telephone and intercom feed.

This output has the following characteristics:

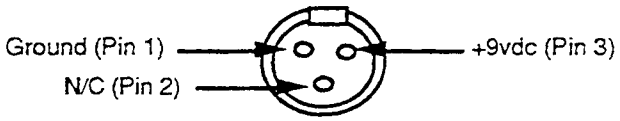
- Approximately 0dBv level.
- Will drive loads of 600Ω or greater.
- Active balanced as per drawing:



If an unbalanced output is desired, it may be taken from either output and ground. In this case, the unused output should be left unconnected.

2.5 POWER SUPPLY

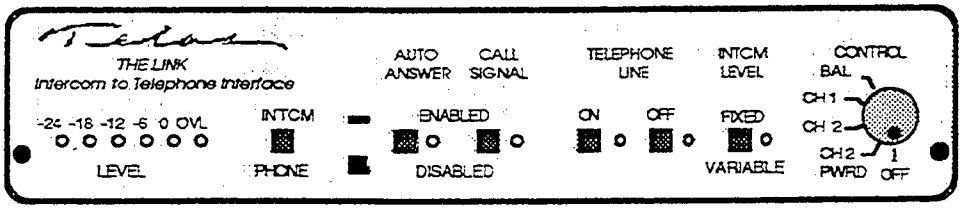
The Link uses a 9vdc plug-in transformer power supply. The connector is a switchcraft mini XLR type. It is wired according to the diagram:



SECTION 3

OPERATION

3.1 FRONT PANEL



Metering

The LED metering indicates either:

- **PHONE:** level from the phone line to the intercom.
- **INTERCOM:** level from the intercom to the phone line.

The pushbutton selects the desired metering mode.

The metering points are after the adaptive nulling function, but before the automatic gain control. This means that the level indicated is what is being received from either the intercom or the phone line. Since the meter has been calibrated to indicate normally expected signal levels, it may be used to determine whether the incoming levels are OK. *The* **INTERCOM** *level indication is affected by the* **INTCM LEVEL** *switch and internal trimmer controls, while the* **PHONE** *level is always a direct indication of phone line level.*

On the phone line side, the meter indicates 0dB when the line level is approximately -10dBm. Phone line levels vary widely. Within approximately a 25dB range, the Link's AGC will adjust the level to feed the intercom system properly.

Auto-Answer Enable

When this function is enabled the Link will automatically switch on and answer an incoming call whenever ring voltage is detected on the telephone line. When the caller hangs up the unit will automatically switch off.

Note: the automatic off function depends upon the telephone central office or PBX to provide a momentary loop current drop or

reversal. While most central offices provide this, some do not. In some cases, a special order must be made to get this feature.

Call Signal Enable

When this function is enabled, the Link will alert intercom users that a call is ringing in. It does this in two ways:

- An audible tone is sent to the intercom line.
- A 20kHz signal is placed on the intercom line. In systems equipped with appropriate detectors, the call lights will flash when telephone line ring voltage is present.

Telephone Line ON/OFF

When the ON button is pressed, the phone line is seized and the system sends a burst of white noise down the telephone line and a two-tone signal to the intercom system to cause system set-up to be accomplished prior to the conversation start.

When the OFF button is pressed, the phone line is released.

Intercom Level

This pushbutton is used to select the appropriate intercom audio level. It should be set as follows for each intercom system listed:

- RTS: **FIXED**
- Clear-Com: **VARIABLE** (factory set to this level)
- ROH: **VARIABLE**
- Telex Audio-Com: **VARIABLE**
- McCurdy:
- Ward-Beck: (4-wire interface)

The intercom audio level is expected to be approximately 0dBv in the FIXED position and is factory set for approximately -10dBv in the VARIABLE position. The internal trimmers can be adjusted to accomodate other levels. Trimmer P1 sets the level from the phone to the intercom. P2 sets the level from the intercom to the phone.

Please note: the meter (in the INTERCOM *position) can be used to set the intercom-to-phone level - however, the meter in the* PHONE *position cannot be used to set the phone-to-com level, since the trimmer is after the metering. The phone-to-com level*

should be set by listening to an intercom station and matching level to other stations.

Control Switch

This rotary switch selects the desired intercom channel and mode.

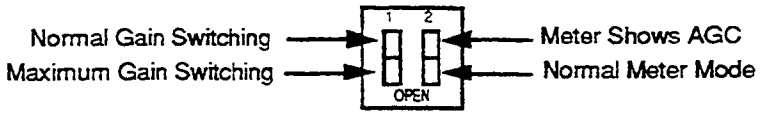
- **CH1:** Selects intercom channel 1.

- **CH2:** Selects intercom channel 2.

- **BAL:** Selects the special balanced mode. This mode should only be used with intercom systems configured for balanced operation.

- **CH2 PWRD:** This a special mode which allows the use of one or two belt packs without the requirement for a separate power supply. *In this mode the Link provides the 18vdc power to the belt packs.* The power is provided on intercom channel 1 and the audio path is channel 2 only.

3.2 INTERNAL DIP SWITCH OPTIONS



SW3

The internal two-position DIP switch is accessable only when the Link case is removed. This is accomplished by first removing the knob, then the front panel, and then sliding the top cover forward. The front panel is fastened with the two black philips screws.

Metering

Either level or AGC may be metered. In the AGC position, the meter indicates either the phone or the intercom AGC depending upon the position of the front panel meter switch. DIP switch 2 is used to select the desired mode. It is normally set to the normal meter mode for monitoring level.

Gain Switching Depth

The Link uses shallow gain switching to improve the system feedback margin. The normal value, about 6dB, is nearly inaudible. That is, the system appears to be simultaneously bi-directional to users. With very difficult phone lines, feedback may be a problem. If this problem occurs, inserting more gain attenuation into the inactive talk path is often the solution. When the DIP switch is on, the gain switching is increased to approximately 18dB. The Link inserts the gain into either the send-to-com or receive-from-com path depending upon which has the most speech energy.

SECTION 4

TECHNICAL DATA and TROUBLESHOOTING

4.1 OVERVIEW

Philosophy

In the past few years, the nature of broadcast engineering has changed considerably. At many stations, the engineering staff has been reduced in size and new responsibilities have been added. At the same time, equipment has gotten more complicated and specialized. Thus, many practitioners of the broadcast electronic arts are forced to become "systems" engineers, emphasizing equipment application rather than component-level troubleshooting.

This is probably a positive development since it really would be impossible for a station engineer to fully understand the internal nuances of all the wonderful new high-tech stuff that is now available to improve station operations! Also, as equipment becomes more sophisticated and specialized, stocking spare parts for every eventuality has become difficult.

Thus, we don't really expect that much component-level troubleshooting will occur. So, to support you when you need help, we keep spare boards available for fast overnight shipping. In most cases, we will swap boards with you at no cost.

However, despite the comments above, we do provide full schematics and component level troubleshooting information in case you have the need or desire to tackle a repair (or modification) yourself. Another reason we provide the information is to satisfy your curiosity. If you are like us, you probably just *have* to know what's happening inside the fancy box. So we tell you.

General Troubleshooting Information

Access to the PC Board:

1) Remove front panel and bezel by removing the knob and then unscrewing the two phillips screws. To remove the knob, the cap is pryed off and the insert loosened with a knob nut tool or pliers.

2) Slide the top cover forward.

If the PC board is to be removed, continue as follows:

3) Slide the board out. The rear panel can remain attached to the PCB.

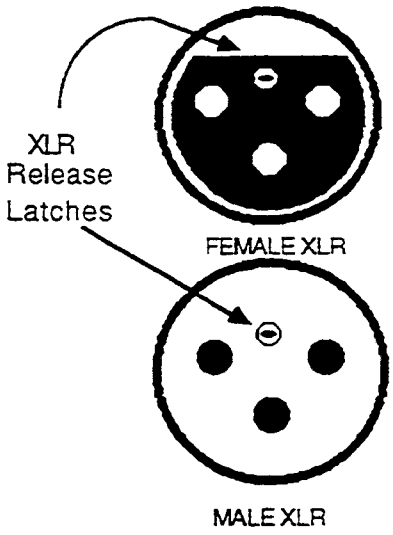
If the rear panel is to be removed:

4) Unscrew the DB9 & DB15 connector retaining screws.

5) The two XLR connectors have retaining screws which have to be turned in order to be released. Do this as illustrated below.

XLR CONNECTOR RELEASE:

Insert a small screwdriver into the holes in the connectors, shown at right. Turn the screwdriver about one eighth of a turn counterclockwise to release the connectors. A small screwdriver such as the Xcelite R3322 or R3324 may need to be filed down some to fit the slots. Remember to retighten the XLR latches when replacing the Telos ONE PCB. This will ensure correct support for the XLR connectors on the PCB.



CAUTION

The installation and servicing instructions in this manual are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Desoldering: While we socket the ICs that have the greatest potential for failure, most of the Link's ICs are soldered in. That's because most of the time the socket is more likely to cause trouble than the IC. This is of no consolation when one of the soldered ICs appears to have failed. When you need to replace a soldered-in chip, the right tool is essential. We use a vacuum desoldering system made by Pace (the MBT-100) and highly recommend it. Cost is about $450 - worth it if you do much PC board troubleshooting work. The only other real alternative is to clip

the leads from the top and remove the solder from the holes with solder-wick. We've not had much luck with the non-heated, manual vacuum desoldering devices such as the one sold by Radio Shack. We do not recommend that newly-soldered connections be defluxed.

Digital Signal Processing

Because the Link makes use of digital signal processing for functions traditionally done in analog, the hardware design of the device is relatively uncomplicated and straightforward. In many ways, the hardware is a "textbook" implementation of a general-purpose processing system.

As in any DSP system, the input signals are passed through anti-aliasing low-pass filters to remove signal components above the Nyquist frequency. In this case, the Nyquist frequency is 4 kHz and the ultimate sampling rate is 8 kHz.

After A/D conversion, the signals are presented to the TMS320C25 DSP processor, where software performs the hybrid and processing functions.

Then, the signals are converted back to analog and filtered to "re-construct" the desired analog audio.

Notation

Whenever a slash (/) is used after a signal designation in the text or on the schematics, an active low is signified.

4.2 DIGITAL SECTION

The Processor and Bus

(Refer to the Processor & I/O Logic Schematic in the DRAWINGS section of this manual.)

The TMS320C25 is a specialized high-speed processor intended for signal processing applications. Despite its unique properties, it

operates much like any other microcomputer from a hardware standpoint.

Program store is provided by the two high-speed EPROMS (U2 & U3). These connect to the bus and are selected directly by the 320C25's assertion of STRB/, PS/(Program Select/) , and R/(W/).

U6, a 74AC138, provides the chip select signals decoded in the usual microprocessor way by expanding the lower address lines.

CS7/ is used to trigger a watchdog timer, U7, at regular intervals. If processor operation should fail, the watchdog reacts by asserting RES/ to the processor, thus restarting it. The watchdog also provides a reliable reset when the +5 V power supply drops below 4.5 V.

U5 is an output port used for the meter as well as for the control input to the CODECS U12 and 13.

U4 is an input port which is used to communicate button status to the processor.

The CODECS have logic outputs. One of these is used to operate the Telco and "A" relays as well as the ON and OFF LEDs. Two others generate the momentary ON and OFF control pulses. All of these signals drive inputs of the ULN2003, U19.

CODEC Interface

The CODECS are interfaced serially to the 320C25 through its on-board serial port. Each CODEC is programmed to occupy a time slot on the serial bus.

Clock and Timing

Clock and timing starts with a 40 MHz clock oscillator module. The 40 MHz output is fed directly to the 320C25. The 74HC390, U9, divides the 40 MHz to 2 MHz in order to generate the CLKR and CLKX signals for U1 and the CODECS. This is the data clock.

The 74HC393 further divides the signal to 8 kHz in order to generate the Frame-Sync input to the DSP and CODECS.

Input/Output Interface

Input control and output status functions are provided via the two D-shells on the rear of the unit. Momentary closures to ground or steady-state levels can be used to remotely seize and release the phone line. These signals are buffered by an LM1489 and diode protected. "A"-lead control is a simple contact closure from K2, available on both of the RJ11 phone jacks (YL/BK pair) as well as on J4.

Output status for RING, AUTO-ANSWER, phone line ON and OFF are open-collector outputs provided by a ULN2003 driver. Also available from the ULN2003 are momentary ON and OFF pulses that can be used for remote start of other equipment.

Troubleshooting hints for the Digital Section

Check the power supply.

Check the 40 MHz oscillator output and the divided-down clock signals to see that they are OK.

Unlike TTL, the CMOS logic IC's used in the Link should have an almost rail-to-rail output.

Make sure that all of the required signals are getting to the CODECS and that the CODECS are outputting data.

None of the logic section IC's should get hot, so if any is, you've found the problem. On rare occasions, a CMOS chip may latch up and get hot, but recover and work normally when power is removed for a time and restored.

Check the 16 data bus lines to see if any are shorted. They should all exhibit lots of activity, as should the lower address bits.

4.3 AUDIO SECTION

(Refer to the Block Diagram and the audio section schematics in the DRAWINGS section of this manual.)

Bilateral Current Source Intercom Interface

The bilateral current source circuit is similar to that used in the common intercom systems. It converts the "two-wire" intercom line (which has the two audio paths mixed together) into separate to-and-from intercom signals. It presents the appropriate impedence and level to the intercom line. The Link incorporates this design so that the unit can be connected directly to the intercom line, as if it were a belt pack, via XLR J1. Please refer to your intercom manual for more details on the intercom system.

Telephone Line Interface

Audio interface to the phone line comes from T1 via the RJ11 jack marked LINE. An RFI filter and MOV are used to keep phone line noise to a minimum and prevent overvoltage damage to other audio circuitry. A single-line phone may be connected to the PHONE jack, which is connected to the phone line (via K1) whenever the telephone line is not seized by the Link.

Miscellaneous Audio Circuits

Telephone and intercom signals are routed to and from the digital domain through U12 & U13, the CODECs. Phone audio is interfaced to U13 using opamps. Intercom audio is routed through U14, a .PCM transmit/receive filter. This IC provides passband filters required to interface the digital section. The MONITOR output (J3) is derived from this chip.

Troubleshooting hints for the Audio Section

Using a scope for signal tracing should do the trick.

All chips should run cool except for non-Signetics brand 5532's - *it is normal for these to run hot.*

4.4 POWER SUPPLY

The Link is powered by an AC wall-plug-in transformer that can provide +9VDC @ 1A (regulated or unregulated). Both the positive and negative supplies are regulated by the ubiquitous

three-terminal regulators. A "gold cap," C3, holds up the power voltage in the event of a brief line voltage dip.

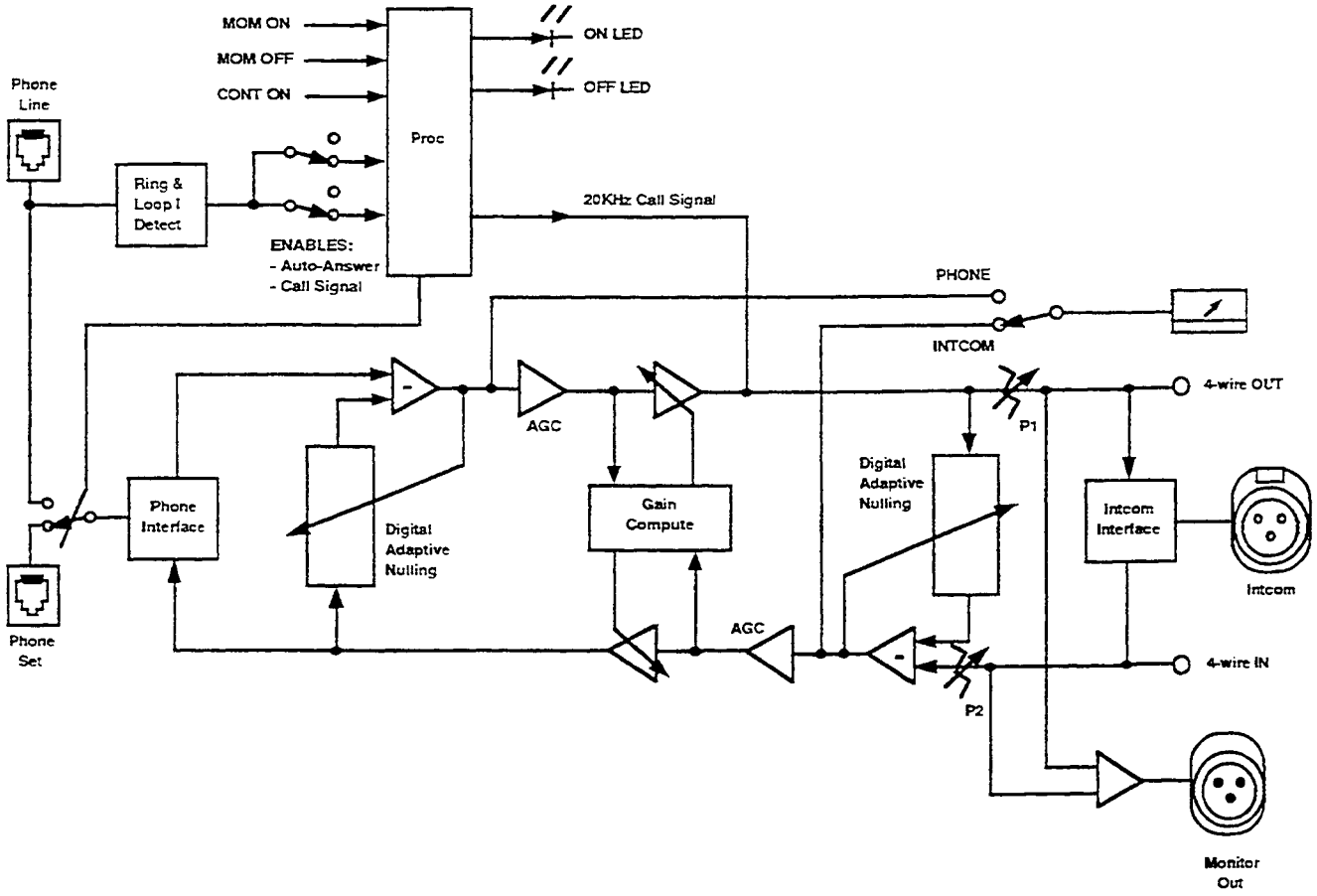
A switching inverter (U18) is used in order to generate the negative voltage required by the CODECS and op-amps. It takes the +9VDC input and inverts it to -9VDC. VR1 then regulates this voltage to -5VDC.

To get enough voltage to power a belt pack (in the CH2 PWRD mode) a high voltage step-up converter is used. It takes the +9VDC input and bumps it up to approximately +18VDC. An external MOSFET (Q1) provides up to 300mA of current.

SECTION 5

DRAWINGS

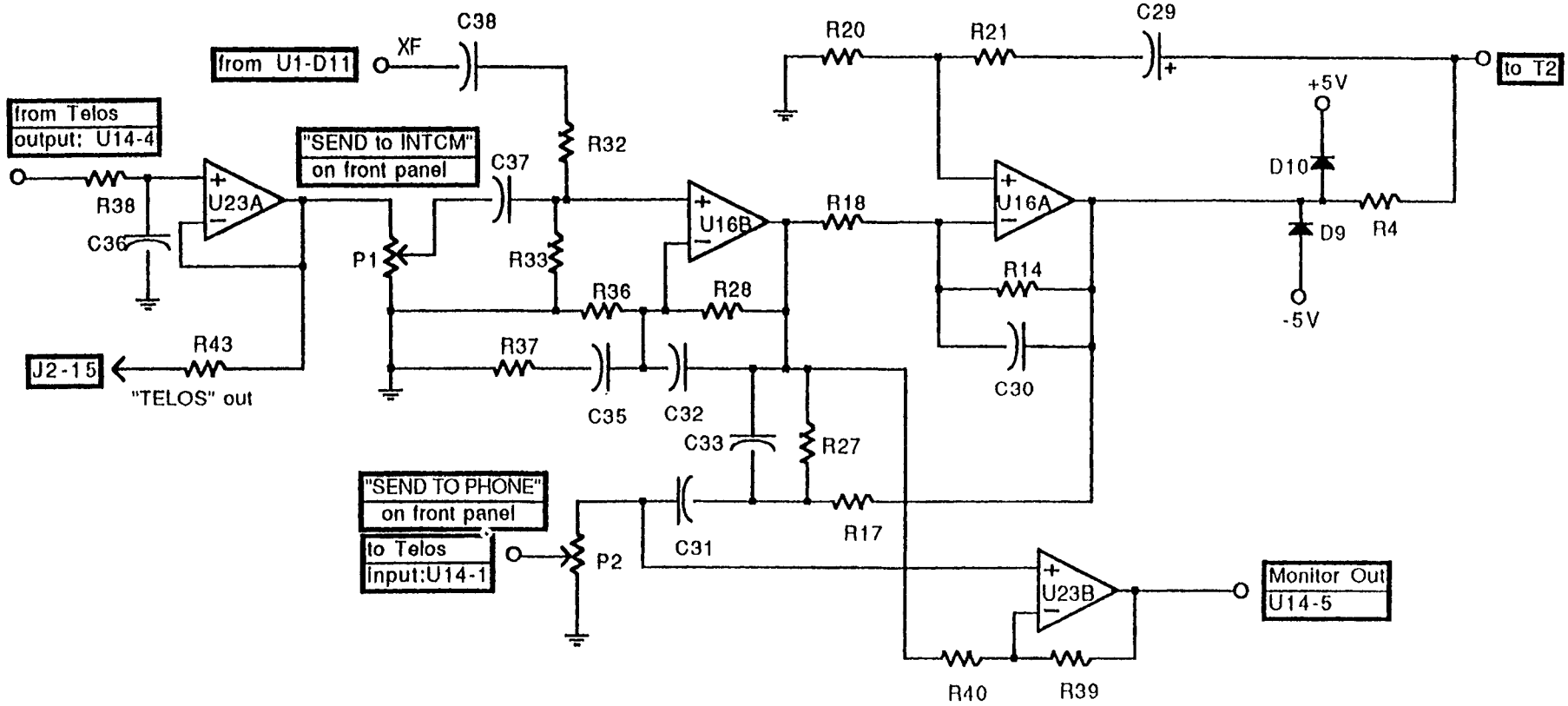
INDEX TO DRAWINGS:



Telos SYSTEMS

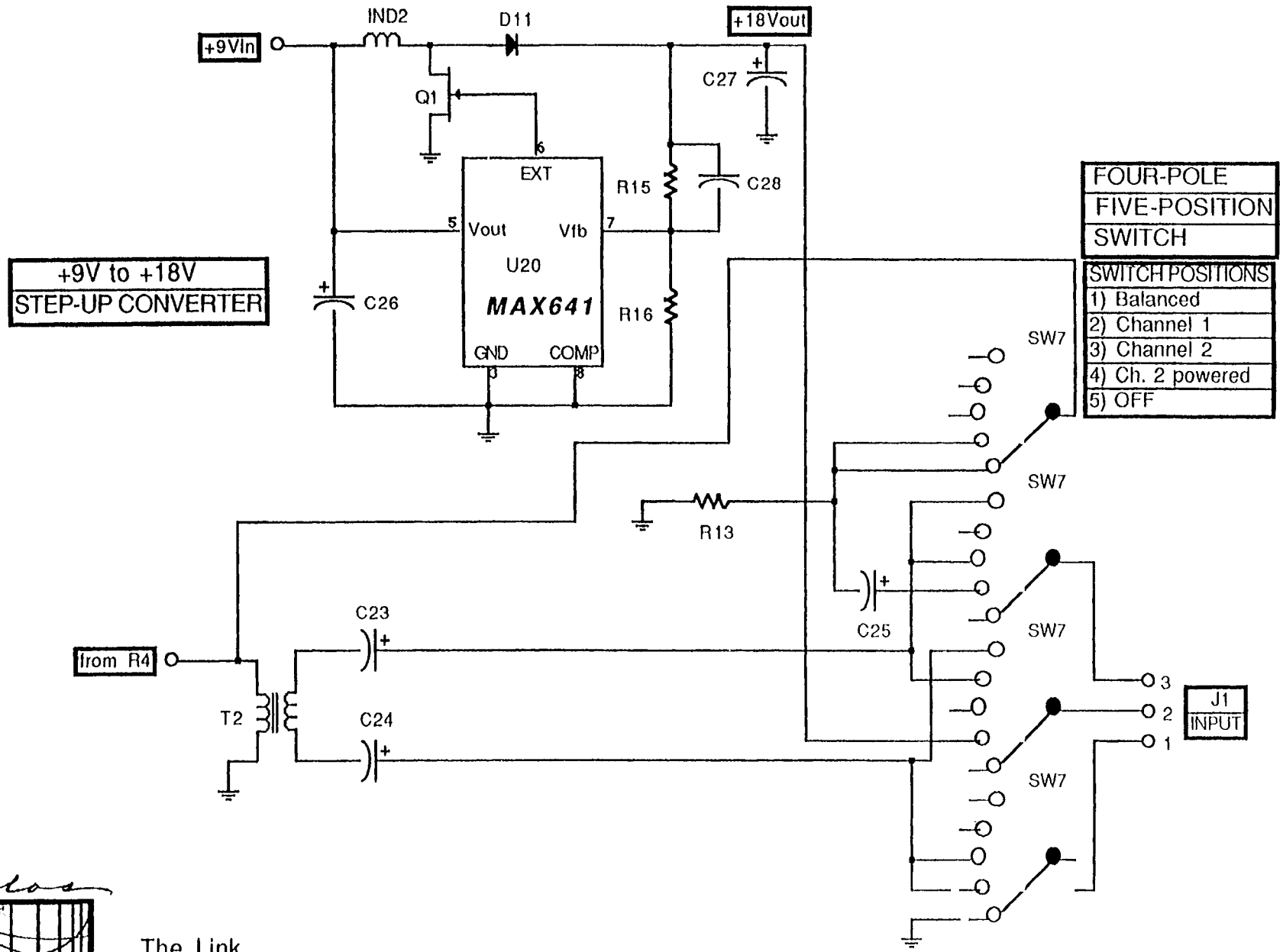
The Link

Block Diagram



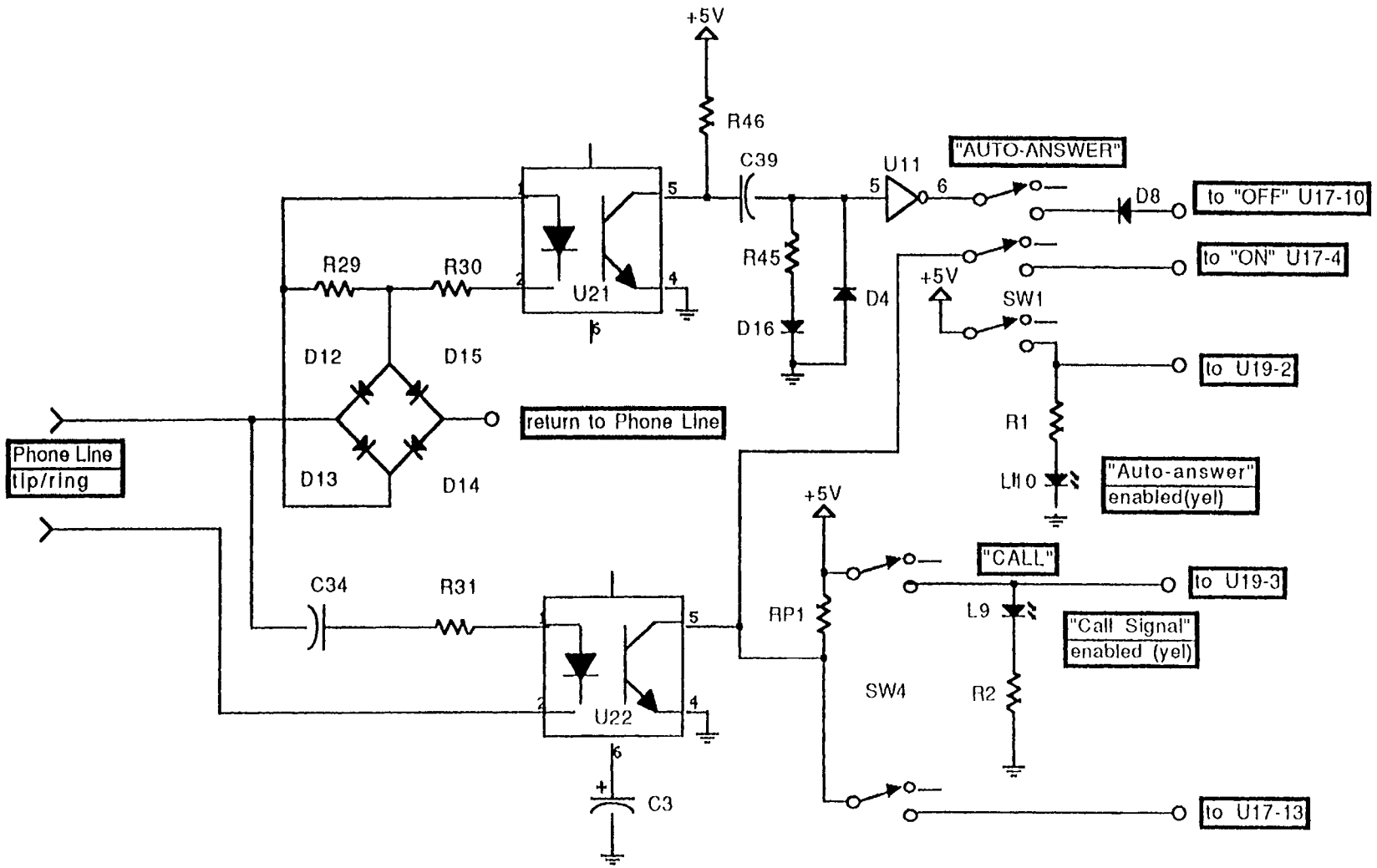
The Link

Bilateral Current Source



The Link

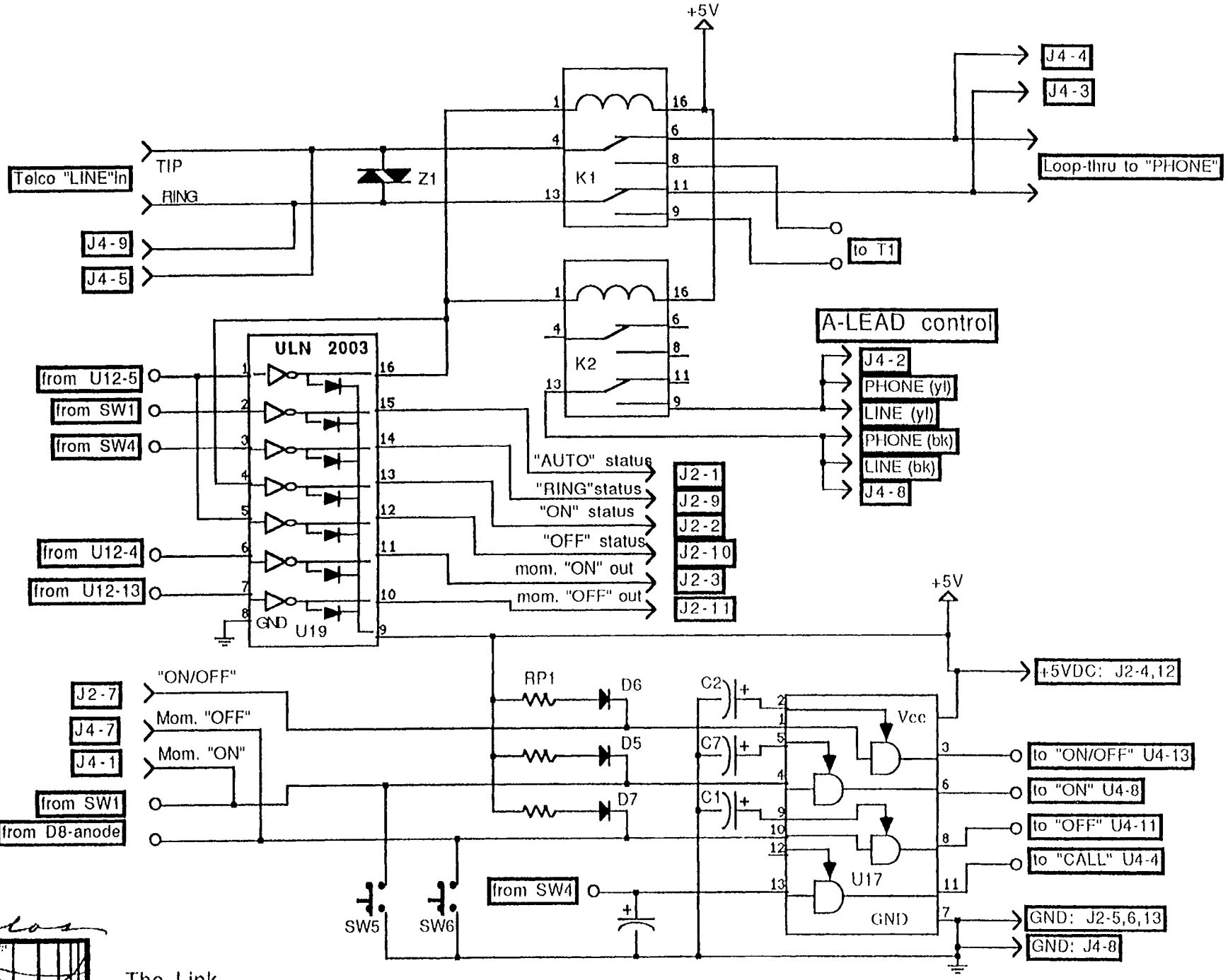
Step-Up Converter and Intcm Switch

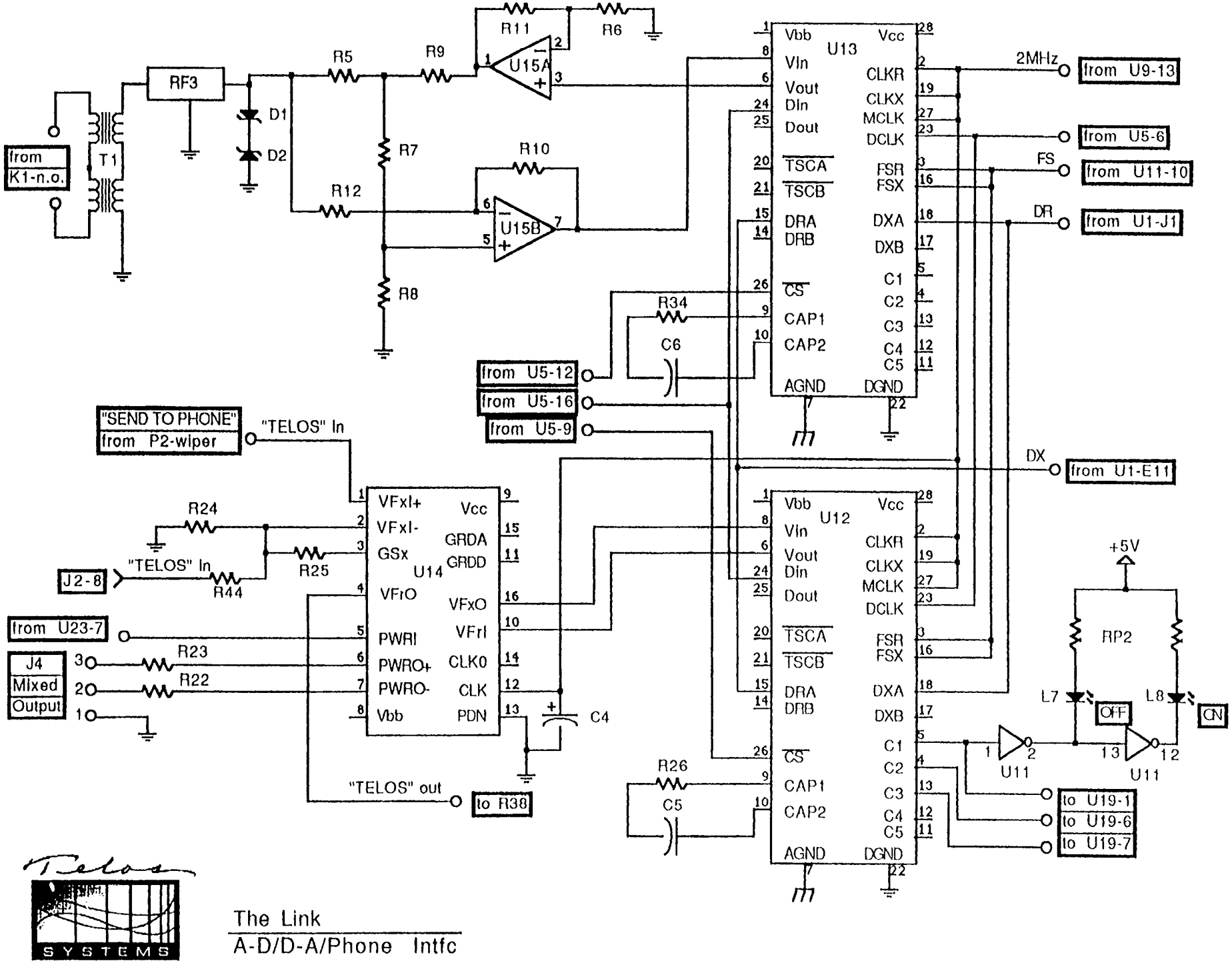


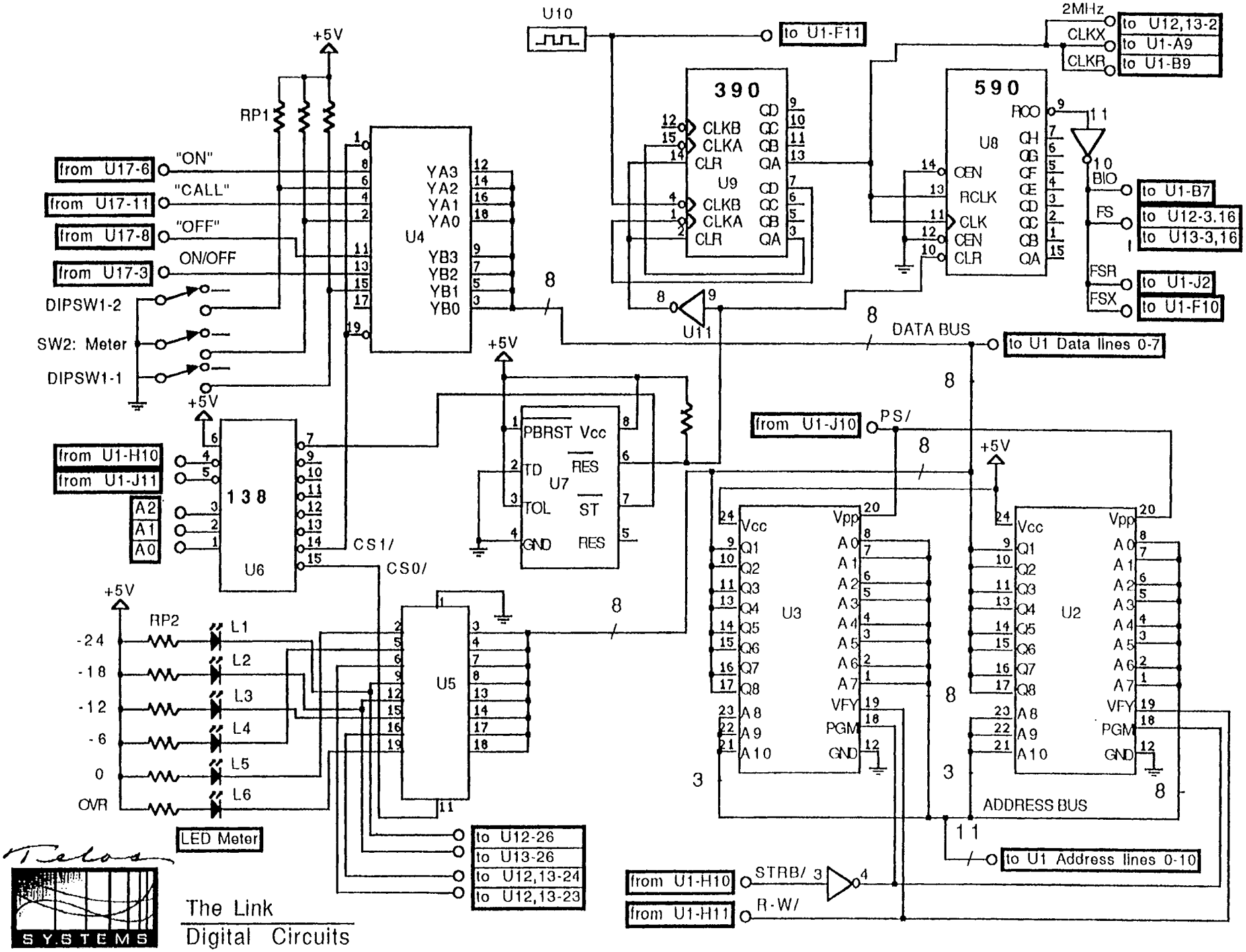
Texas SYSTEMS

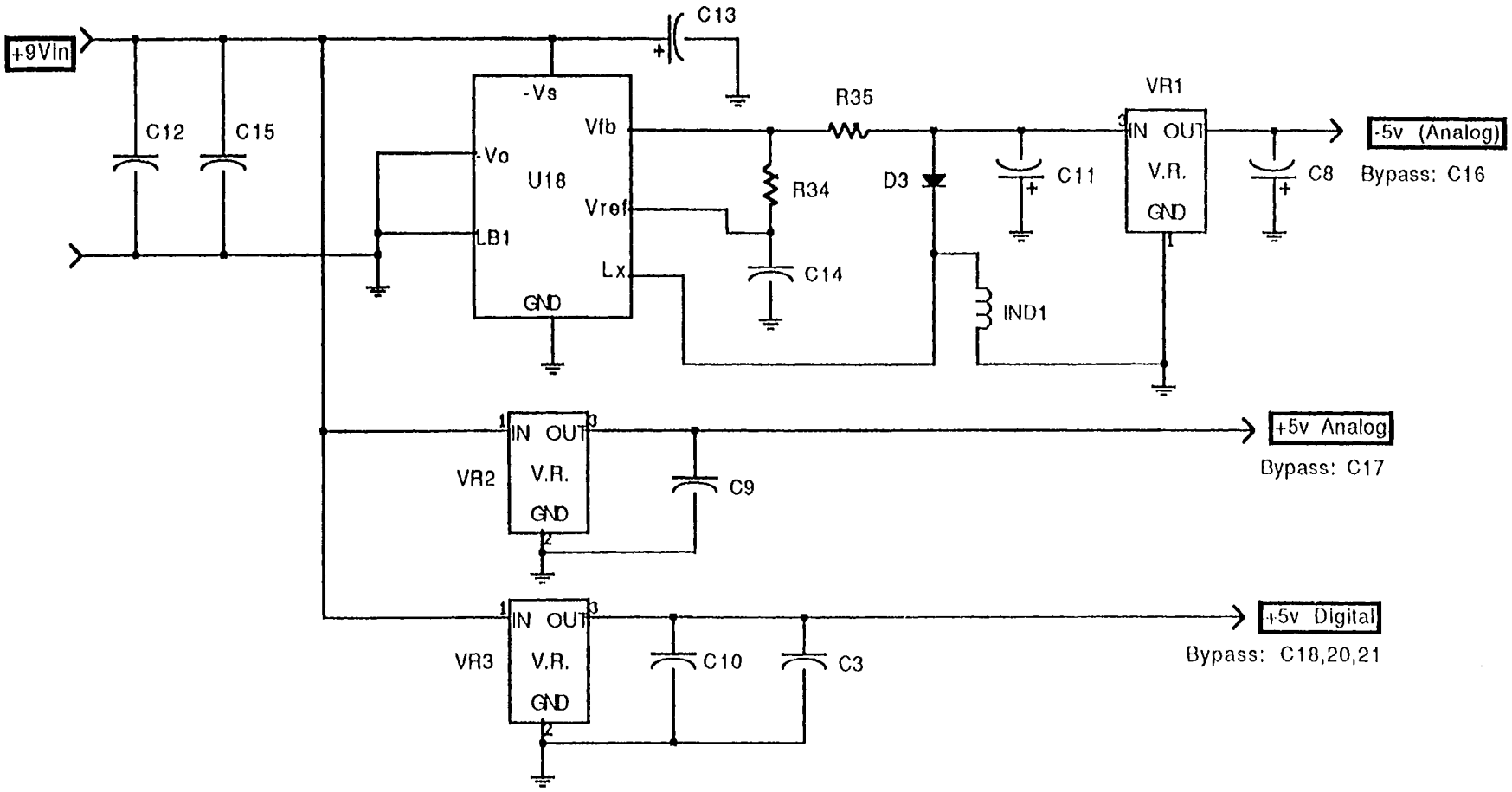
The Link

Auto-Answer/Release


+5V
J4-4
J4-3
Loop-thru to "PHONE"
Telco "LINE"In
TIP
RING
J4-9
J4-5
Z1
K1
to T1
K2
A-LEAD control
J4-2
PHONE (yl)
LINE (yl)
PHONE (bk)
LINE (bk)
J4-8
ULN 2003
from U12-5
from SW1
from SW4
from U12-4
from U12-13
GND
U19
"AUTO" status
"RING"status
"ON" status
"OFF" status
mom. "ON" out
mom. "OFF" out
J2-1
J2-9
J2-2
J2-10
J2-3
J2-11
+5V
+5VDC: J2-4,12
J2-7
J4-7
J4-1
"ON/OFF"
Mom. "OFF"
Mom. "ON"
from SW1
from D8-anode
RP1
D6
D5
D7
C2
C7
C1
Vcc
U17
GND
to "ON/OFF" U4-13
to "ON" U4-8
to "OFF" U4-11
to "CALL" U4-4
GND: J2-5,6,13
GND: J4-8
from SW4
SW5
SW6
Telos
SYSTEMS
The Link
I/O and Control


from K1-n.o.
T1
RF3
D1
D2
R5
R9
R11
R6
U15A
R7
R10
R12
U15B
R8
U13
Vbb
Vcc
Vin
CLKR
Vout
CLKX
Din
MCLK
Dout
DCLK
TSCA
FSR
TSCB
FSX
DRA
DXA
DRB
DXB
CS
C1
CAP1
C2
CAP2
C3
C4
C5
AGND
DGND
2MHz
from U9-13
from U5-6
FS
from U11-10
DR
from U1-J1
R34
C6
from U5-12
from U5-16
from U5-9
"SEND TO PHONE"
from P2-wiper
"TELOS" In
DX
from U1-E11
U14
VFxI+
VFxI-
GSx
VFrO
PWRI
PWRO+
PWRO-
Vbb
Vcc
GRDA
GRDD
VFxO
VFrI
CLK0
CLK
PDN
R24
R25
R44
J2-8
"TELOS" In
from U23-7
J4
Mixed
Output
R23
R22
C4
U12
R26
C5
"TELOS" out
to R38
+5V
RP2
L7
L8
OFF
ON
U11
U11
to U19-1
to U19-6
to U19-7
The Link
A-D/D-A/Phone Intfc
SYSTEMS

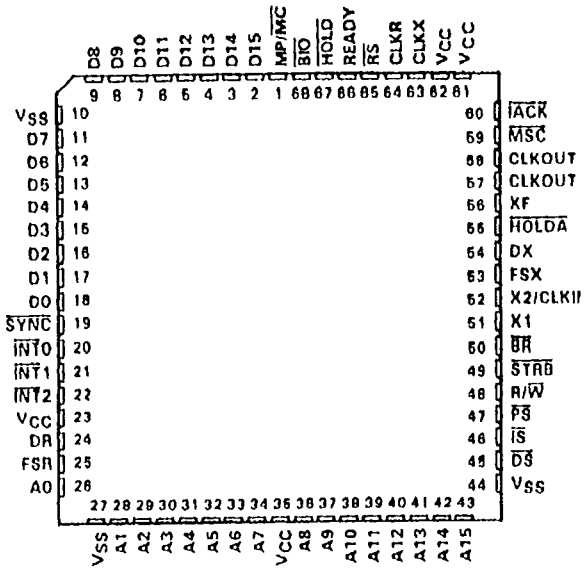

U10
to U1-F11
2MHz
CLKX
CLKR
to U12,13-2
to U1-A9
to U1-B9
390
590
U8
U9
RCO
CLKB
CLKA
CLR
OEN
RCLK
CLK
CEN
QA
QB
QC
QD
QE
QF
QG
QH
BIO
FS
FSR
FSX
to U1-B7
to U12-3.16
to U13-3,16
to U1-J2
to U1-F10
+5V
RP1
from U17-6
"ON"
from U17-11
"CALL"
from U17-8
"OFF"
from U17-3
ON/OFF
DIPSW1-2
SW2: Meter
DIPSW1-1
U4
YA3
YA2
YA1
YA0
YB3
YB2
YB1
YB0
U11
DATA BUS
to U1 Data lines 0-7
PBRST
Vcc
TD
RES
TOL
ST
GND
U7
from U1-J10
PS/
from U1-H10
from U1-J11
A2
A1
A0
138
U6
CS1/
CS0/
RP2
-24
-18
-12
-6
0
OVR
L1
L2
L3
L4
L5
L6
LED Meter
U5
to U12-26
to U13-26
to U12,13-24
to U12,13-23
U3
U2
Vpp
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
A8
A9
A10
VFY
PGM
ADDRESS BUS
to U1 Address lines 0-10
from U1-H10
STRB/
from U1-H11
R-W/
Telos
SYSTEMS
The Link
Digital Circuits



Telos SYSTEMS

The Link

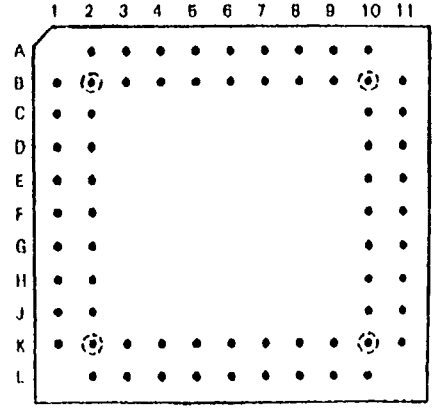
Power Supply Circuits



PIN ASSIGNMENTS

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
A2	D8	C11	CLKOUT1	J10	$\overline{PS}$
A3	D10	D1	D4	J11	$\overline{IS}$
A4	D12	D2	D3	K1	A0
A5	D14	D10	CLKOUT2	K2	A1
A6	MP/$\overline{MC}$	D11	XF	K3	A3
A7	$\overline{HOLD}$	E1	D2	K4	A5
A8	$\overline{RS}$	E2	D1	K5	A7
A9	CLKX	E10	$\overline{HOLDA}$	K6	A8
A10	V_{CC}	E11	DX	K7	A10
B1	V_{SS}	F1	D0	K8	A12
B2	D7	F2	$\overline{SYNC}$	K9	A14
B3	D9	F10	FSX	K10	$\overline{DS}$
B4	D11	F11	X2/CLKIN	K11	V_{SS}
B5	D13	G1	$\overline{INT0}$	L2	V_{SS}
B6	D15	G2	$\overline{INT1}$	L3	A2
B7	$\overline{BIO}$	G10	X1	L4	A4
B8	READY	G11	$\overline{BR}$	L5	A6
B9	CLKR	H1	$\overline{INT2}$	L6	V_{CC}
B10	V_{CC}	H2	V_{CC}	L7	A9
B11	$\overline{IACK}$	H10	$\overline{STRB}$	L8	A11
C1	D8	H11	R/$\overline{W}$	L9	A13
C2	D5	J1	DR	L10	A15
C10	$\overline{MSC}$	J2	FSR		

68-PIN GB
PIN GRID ARRAY CERAMIC PACKAGE†
(TOP VIEW)



† See Pin Assignments Table (Page 1) and Pin Nomenclature Table (Page 2) for location and description of all pins.

TEXAS INSTRUMENTS

This Warranty covers "the Products," which are defined as the various audio equipment, parts, software and accessories manufactured, sold and/or distributed by TLS Corp.,d/b/a Telos Systems (hereinafter "Telos Systems").

With the exception of software-only items, the Products are warranted to be free from defects in material and workmanship for a period of one year from the date of receipt by the end-user. Software-only items are warranted to be free from defects in material and workmanship for a period of 90 days from the date of receipt by the end-user.

The terms and conditions of Telos Systems' warranty in effect at the time of shipment shall apply.

In order to invoke this Warranty, notice of a warranty claim must be received by Telos Systems within the above-stated warranty period and warranty coverage must be authorized by Telos Systems. Notice of a warranty claim may be made orally by telephoning Telos Systems at +1 (216) 241-7225 or in writing sent by facsimile to +1 (216) 241-4103. If Telos Systems authorizes the performance of warranty service and if Telos Systems will be performing the warranty service, the defective Product must be delivered, shipping prepaid, to: Telos Systems, 2101 Superior Avenue, Cleveland, Ohio 44114, USA. If Telos Systems authorizes the performance of warranty service and if it authorizes another entity to perform that warranty service, the Product must be delivered, shipping prepaid, to that entity, whose address will be provided by Telos Systems.

Telos Systems (or its designee) at its option will either repair or replace the Product and such action shall be the full extent of Telos Systems' obligation, and buyer's sole remedy, under this Warranty.

After the Product is repaired or replaced, Telos Systems (or its designee) will return it to the party that sent the Product and Telos Systems will pay for the cost of shipping.

Telos Systems will have no responsibility under this Warranty for any Products subject to: Acts of God, including (without limitation) lightning; improper installation or misuse, including (without limitation) the failure to use telephone and power line surge protection devices; accident; neglect or damage.

Telos Systems' dealers are not authorized to assume for Telos Systems any additional obligations or liabilities in connection with the dealers' sale of the Products.

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