GSI TYMPSTAR Service Manual

Part Number 2000–0110 Rev B

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Middle-Ear Analyzer
Service Manual

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Warranty for the GSI TympStar Versions 1 & 2

Grason-Stadler warrants the GSI TympStar Versions 1 and 2 to be free of original defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of one year from the date of purchase. If this instrument or any component thereof is found to be defective or at variance from the manufacturer's specifications during the warranty period, Grason-Stadler will repair, replace, or recalibrate the instrument or component at no cost to the purchaser.

This warranty only applies to instruments purchased new from Grason-Stadler or its authorized distributors or representatives. The purchaser must return the instrument directly to Grason-Stadler or an authorized GSI TympStar distributor or representative and bear the costs of shipping.

This warranty does not cover breakage or failure due to tampering, misuse, neglect, accidents, modification, or shipping, and is void if the instrument is not used in accordance with manufacturer's recommendations or if repaired or is serviced by other than Grason-Stadler or a Grason-Stadler authorized representative.

WARNING

The GSI TympStar Versions 1 and 2 are designed to be used with a hospital grade outlets. Injury to personnel or damage to equipment can result when a three-prong adapter is connected between the instrument's power plug and an A/C outlet or extension cord.

Accessory Hazard Warning

This IEC 601-l/CSA C22.2 No. 601.1M90 listed medical instrument should be interconnected with accessories that have proper electrical compatibility and which are listed as conforming to Part 1: General Requirements for Safety of the UL Medical Electrical Equipment Standard UL2601-1. Connection of accessories not meeting these requirements may result in electrical leakage currents in excess of those allowed by the standard and present a potential electrical shock hazard to the person being tested.

User manuals

Installation, setup and operating information can be found in the Reference Instruction Manuals:

TympStar Version 1: 2000-0100
TympStar Version 2: 2000-0120

Service personnel

Repair and/or bench testing of the GSI TympStar Version 1 and Version 2 instruments should be performed only by trained personnel. The following instructions are provided primarily for use by persons who are skilled in the repair of electronic equipment.

Electrical safety

CAUTION

The GSI TympStar Version 1 and Version 2 instruments are IEC 601-1/CSA approved; consequently, if any parts are replaced during the repair of these units, only exact replacements should be made. Any alterations of the present electrical or mechanical construction or components will void these safety approvals.

CMOS handling

Many of the integrated circuits on the PC Boards are constructed of CMOS and NMOS materials. **Please observe the following precautions:**

CAUTION

Failure to observe the following precautions whenever a circuit board or an integrated circuit package is handled can result in damage to the GSI TympStar Version 1 or Version 2 instrument. Please observe these precautions:

1) Place the instrument and parts on a grounded, conductive work surface.
2) Ground yourself (with a strap having about 1 Meg-Ohm resistance) to discharge or prevent static charges.
3) Ground the frame of any test instrument or soldering iron to be used.
4) If any circuit boards are to be stored or transported, enclose them in conductive (antistatic) envelopes.

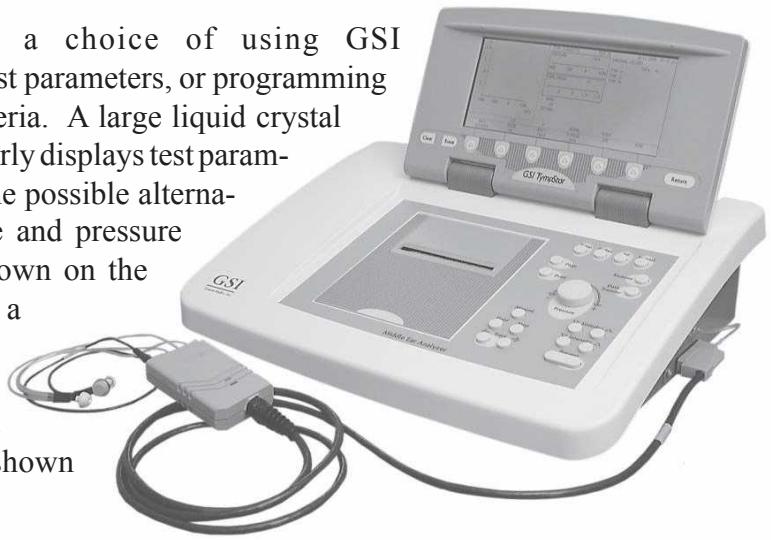
Contents

Introduction 1

General

The GSI TympStar Version 1 and Version 2 Middle-Ear Analyzers are technically advanced, computer-based admittance instruments designed to be used in clinical or research settings. The TympStar builds on the sophistication, functionality and flexibility of the GSI 33, offering unparalleled testing capabilities. It contains total capabilities for complete, manual or automatic diagnostic testing for analysis of middle ear function.

Operators have a choice of using GSI preprogrammed test parameters, or programming their own test criteria. A large liquid crystal display (LCD) clearly displays test parameter choices and the possible alternatives. Admittance and pressure indications are shown on the LCD along with a continuous digital readout. Test status and invalid choices are also shown on the LCD.



Test results are displayed in real-time. The user can view the results as they are being measured and then has the choice of printing the display or retesting the patient. The high-speed printer generates reports in concise graphical formats that are easy to read.

This manual addresses the service requirements of the Version 1 and the Version 2 instruments, and calls attention to the differences when necessary. Please refer to the appropriate User Manual for more detailed information regarding instrument installation and operation.

Version 1

Admittance (Y) may be measured with a probe tone frequency of 226 Hz. The extensive battery of test mode choices include the following:

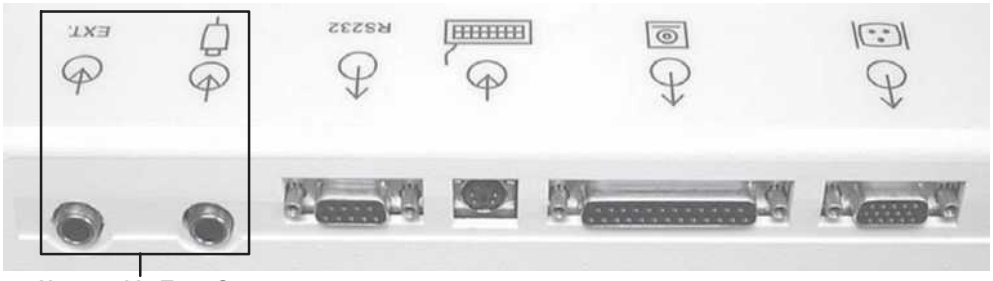
- Diagnostic Tympanometry
- Acoustic Reflex Threshold and Decay Measurements
- Eustachian-Tube Function Testing (both intact and perforated eardrums)
- Screening Tympanometry/Reflex (automatic only)

The tympanometric measurement results are automatically scaled and presented in equivalent ml of compliance at "Y" 226 Hz. Sensitivity scales for the display of reflex measurement results can be selected manually. A cursor is available in all test modes for calling out numeric positions on the X and Y axes.

Version 1 equipment connections and options

TympStar Version 1 options that can be connected to the rear panel include RS232 serial communication, a keyboard for entering patient information and a VGA monitor for displaying test results. Other options offered for the TympStar Version 1 for managing and archiving data, include the following:

- Internal memory for storing up to 26 test results
- Data export to an external PC via RS232 serial interface



Version 2

Admittance (Y), and its components, Susceptance (B) and Conductance (G), may be measured with probe tone frequencies of 226, 678, and 1000 Hz. The extensive battery of test mode choices include the following:

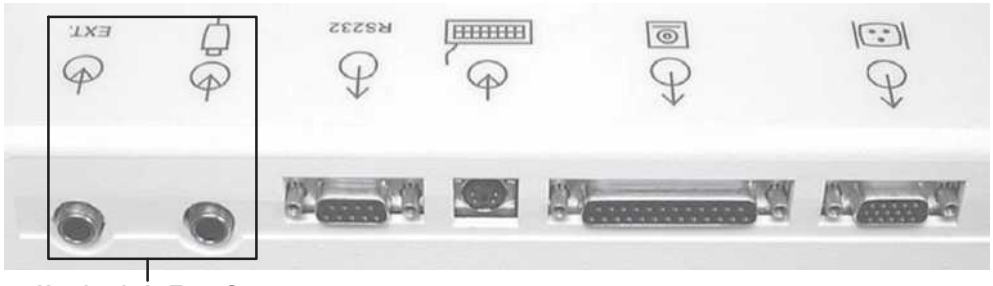
- Diagnostic Tympanometry
- Acoustic Reflex Threshold and Decay Measurements
- Eustachian-Tube Function Testing (both intact and perforated eardrums)
- Screening Tympanometry/Reflex (automatic only)
- Acoustic Reflex Latency Testing
- Acoustic Reflex Sensitization
- Multiple Frequency Tympanometry (250 Hz to 2000 Hz)

The tympanometric measurement results are automatically scaled and presented in equivalent ml of compliance at "Y", 226 Hz. All "B" and "G" measurements and measurements performed at probe tone frequencies of 678 Hz and 1000 Hz are expressed in mmhos. Sensitivity scales for the display of reflex measurement results can be selected manually. Reflex test stimuli can be input from an external source and presented via external control. A cursor is available in all test modes for calling out numeric positions on the X and Y axes.

Version 2 equipment connections and options

TympStar options that can be connected to the rear panel include an external stimulus source, an external Present control, RS232 serial communication, a keyboard for entering patient information and a VGA monitor for displaying test results. Other options offered for the TympStar for managing and archiving data, include the following:

- Internal memory for storing up to 26 test results
- Data export to an external PC via RS232 serial interface

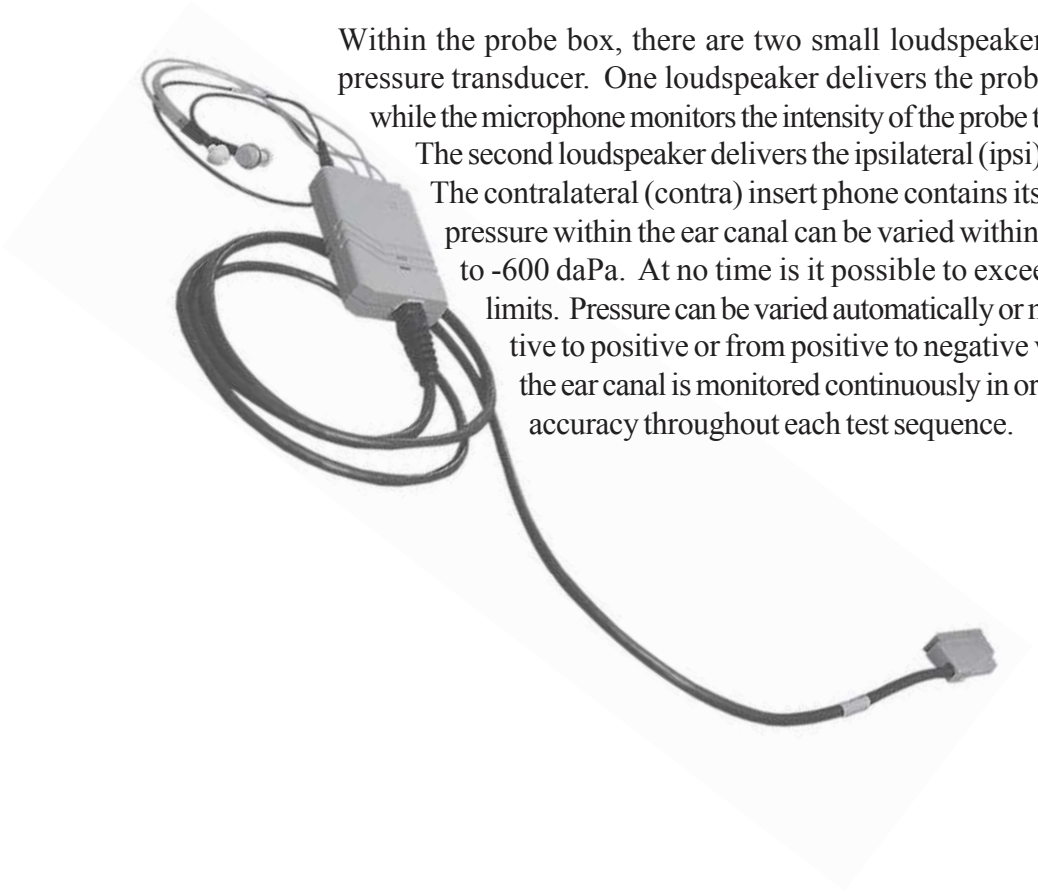


Used only in TympStar Version 2

The probe

The innovative lightweight probe is designed for patient comfort, ease-of-seal, and accurate test results. A wide variety of both standard and special sized eartips are supplied with the GSI TympStar to hermetically seal the ear canal. In addition, a set of screening eartips is provided for screening tymp and reflex tests.

The operator has a choice of three mountings to support the probe box; the standard lightweight shoulder mounting, standard clothes clip, or an optional operator wrist attachment. The probe box has 2 LED's to indicate test status.



Within the probe box, there are two small loudspeakers, a microphone and a pressure transducer. One loudspeaker delivers the probe tone to the ear canal, while the microphone monitors the intensity of the probe tone within the ear canal. The second loudspeaker delivers the ipsilateral (ipsi) stimuli to the ear canal. The contralateral (contra) insert phone contains its own loudspeaker. The pressure within the ear canal can be varied within the range of +400 daPa to -600 daPa. At no time is it possible to exceed specified maximum limits. Pressure can be varied automatically or manually and from negative to positive or from positive to negative values. Pressure within the ear canal is monitored continuously in order to maintain pressure accuracy throughout each test sequence.

Instrument controls

A combination of hardkeys and softkeys are used to select the test modes and parameters and to conduct tests.

Hardkeys and softkeys

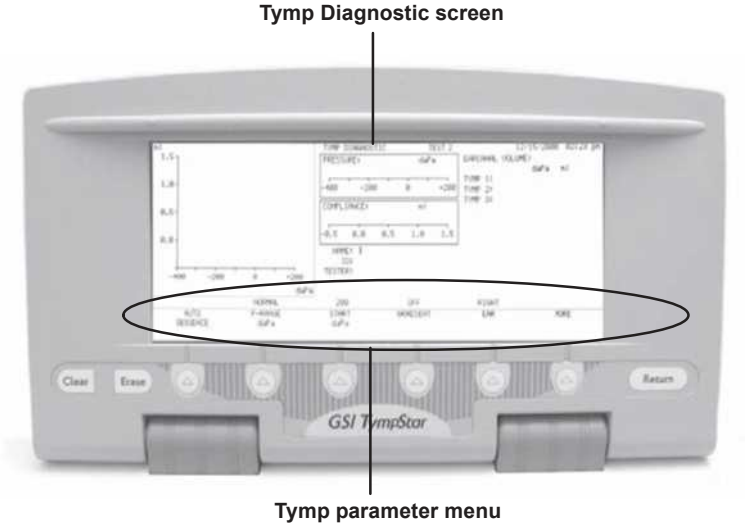
Hardkeys are located on the front panel and the sides of the LCD panel and provide fixed functions that do not change. Softkeys are located directly under the LCD and change to support the requirements of a test session.

Rotary pressure control

A rotary pressure control is also provided to change or fine-tune pressure within the ear canal.

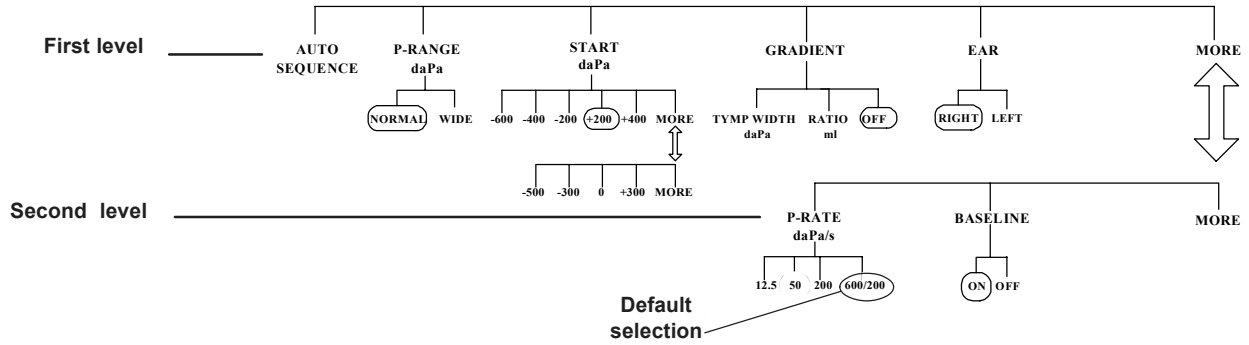
Test modes and menu navigation

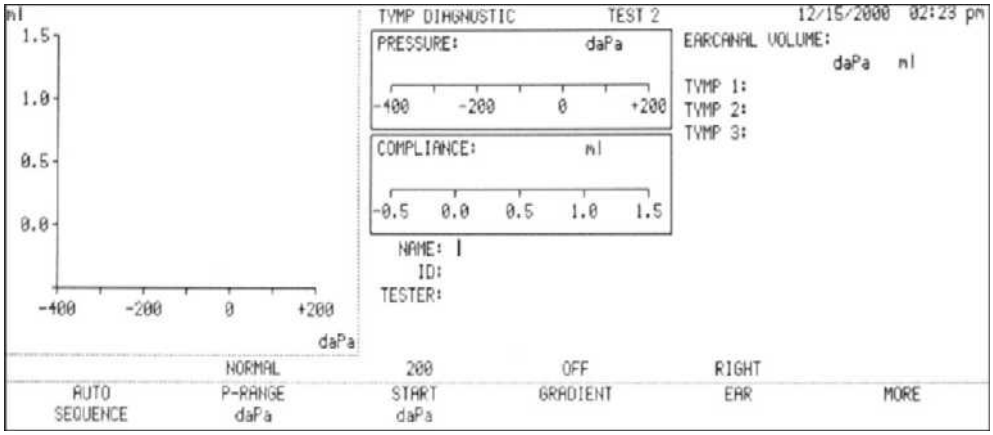
Selecting a test mode by pressing a hardkey causes the required test screen to be displayed on the LCD with the appropriate menu of test parameters shown across the bottom. The softkeys are then used in conjunction with hardkeys to navigate through the menus and set parameter values for the selected tests. For example, pressing the TYMP hardkey causes the Tymp Diagnostic screen to be displayed.



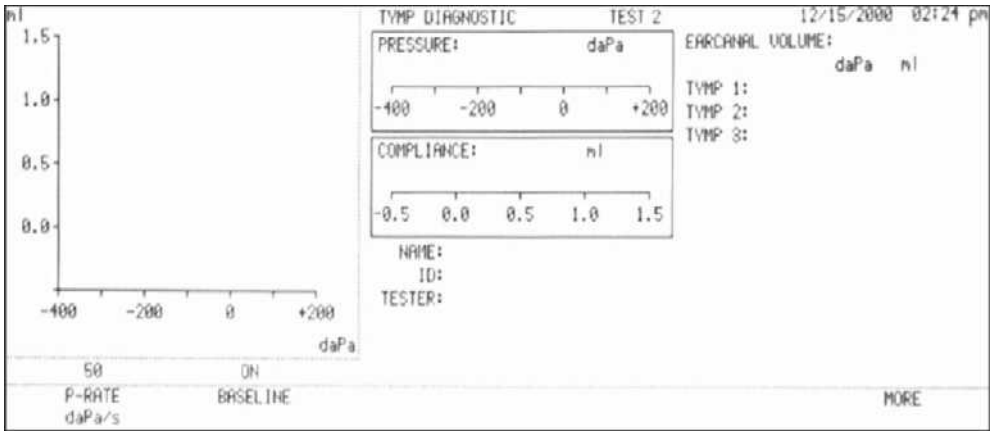
Pressing the softkeys displayed across the bottom of the LCD allows the user to navigate through the Tymp Diagnostic parameter menus diagrammed below. These menus are from the Version 1, however, the process is the same in both versions. GSI default softkey selections are circled on menu diagrams.

The first level of parameter menu selections includes AUTO SEQUENCE, P-RANGE, START, GRADIENT, EAR and MORE.



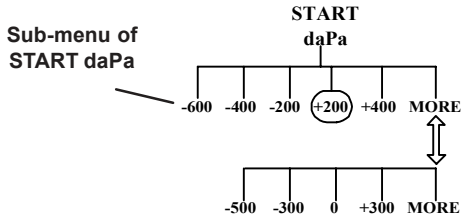


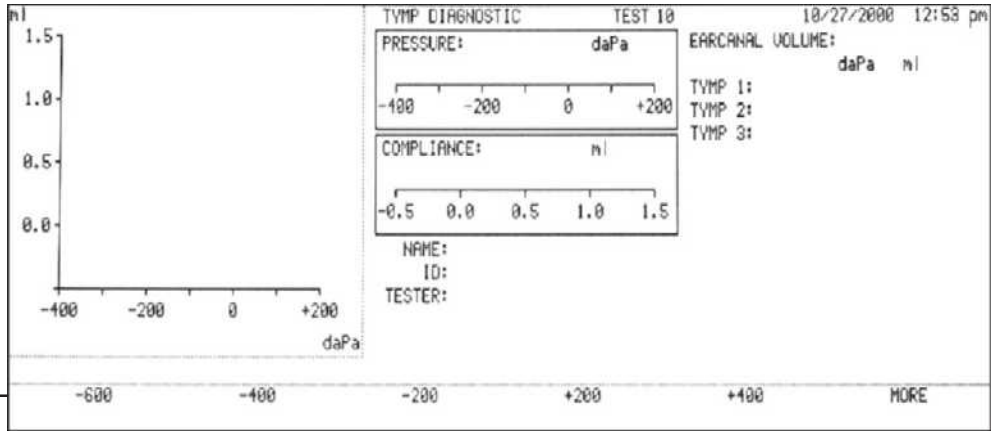
A second level of menus can be displayed by pressing the MORE softkey and includes P-RATE, BASELINE and MORE.



The MORE softkey is used to toggle between the top and lower levels of menus while the test screen portion above the softkeys remains unchanged.

Pressing a parameter menu softkey causes a sub-menu of parameter settings to be displayed. Often sub-menus will also contain MORE softkey selections that provide access to additional setting alternatives.





Sub-menu of START daPa

Changing parameter settings

Settings can be changed for a selected parameter by pressing the desired softkey as shown in this example of changing the Probe Hz from 226 to 1000.

Making the new selection returns the display to the previous menu level with the new setting shown above the selected parameter.

If no change is desired, the display can be returned to the previous level by pressing the RETURN hardkey.

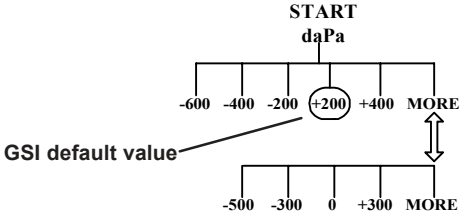
In the manner described above, menus can be navigated and settings can be changed for any of the test modes.

Menu diagrams

Menu structure diagrams, like the diagrams shown on these pages, will be used throughout the remainder of this manual as a convenience to the user.

GSI default parameter settings

GSI default parameters are circled on menu structure diagrams shown throughout the remainder of this manual.



Specifications 2

Introduction

Detailed specifications are provided in this chapter for the TympStar Version 1 and TympStar Version 2 instruments. The specifications for each instrument can also be found in its corresponding Reference Instruction Manual.

Version 1 Specifications

Standards

The GSI TympStar Version 1 meets or exceeds the following standards and specifications for aural acoustic admittance instruments:
IEC 1027 1991-03
ANSI S3.39-1987
ANSI S3.6-1996
ANSI S3.7-1995
IEC 645-1 1992
IEC 126-1973 (also BS 6111-1981)
BS ISO 389-2 1994

Y2K Compliant
UL 2601-1 Part 1: General Requirements for Safety
CSA C22.2 No. 601.1-M90 (Canada)
CE 0344 CE Mark per Medical Device Directive (93/42/EEC)

EN60601-1:1990 Safety Requirements for Medical Electrical Equipment
EN60601-1-2 Medical Electrical Equipment Emissions and Immunity Requirements

This equipment has been tested for radio frequency emissions and has been verified to meet Radiated and Conducted Emissions per EN 55011-1998, Group 1, Class A and per CISPR, Class A.

Sensitivity ranges

The following admittance measurements give maximum range at 226 Hz, Y in ml.

Table 1: Tymp Mode

Frequency	Digital Read-Out Including Cursor	Graphical Display
226 Hz	-7.0 to +7.0	-1.0 to +7.0

Accuracy at 226Hz: 0.1 ml or 5%, whichever is greater.

Table 2: Reflex Mode

Frequency	Digital Read-Out Including Cursor	Graphical Display
226 Hz	-7.0 to +7.0	-0.16 to +0.80 +0.16 to -0.80

Accuracy: 226 Hz is 0.02 ml or 5%,whichever is greater.

Probe signal

Sinusoidal signal with the following characteristics:
Frequency: 226 Hz
Frequency accuracy: ±1%
Harmonic distortion: <2%
(Measured in an HA-1 2cc coupler)
Signal level: 85 dB SPL
(In Real Ear and in Normal Test Mode)

NOTE
The probe tone level is set to be nominally 70 dB HL.

Signal level accuracy: ±1.5 dB SPL

Pneumatic System

Pressure Maximum Limits: -800 daPa to +600 daPa
Programmed Pressure Ranges:
Normal: + 200 to - 400 daPa
Wide: + 400 to - 600 daPa
Pressure Accuracy: ±10% or ±10 daPa, whichever is greater in cavities from 0.5 cc to 5.0 cc.
Pressure Sweep Rate: 12.5 daPa/sec
50 daPa/sec
600/200 daPa/sec
Manual Sweep Rate Limit: 600 daPa/sec
Sweep Rate Accuracy: ±10%
Pressure System Leak Rate: < 1. 0 daPa/sec
(Measured at -600 and +400 daPa, while pressure servo is disabled.)

Acoustic Reflex Activating (Stimulus) Signal

Pure Tone Stimulus

Frequencies for Contra phone and for Ipsi phone with time multiplexed stimulus. See Table 3.

Frequency Accuracy: ±3%
Total Harmonic Distortion :
< 5% at 500 Hz, 85dBHL
< 5% at 1000Hz - 3000Hz, 100dBHL
< 5% at 4000Hz, 75dBHL
< 10% at the maximum dBHL settings

Reference:
ANSIS3.39-1987
Section 7.5.2.2 Frequency Accuracy
Section 7.5.2.3 Harmonic Distortion

Noise Stimulus

The uniformity of the spectrum level of acoustic pressure for the noise signal over 20 averages measured acoustically within their respective band limits will be:
±10 dB for insert or probe type earphones
±5 dB for supra-aural type earphones
Noise Band Widths:
Low Band: 125 -1600 Hz
High Band: 1600 - 4000 Hz
Broad Band: 125 - 4000 Hz (Relative to level at 1 kHz)
Band-edges accurate to within ±15%
Roll off rate: >12 dB/Octave

Stimulus Level Control

Tone Stimulus: The transfer of reference equivalent threshold values are based on the article; “Reference Threshold Levels For The ER-3A Insert Phone”, by Laura Ann Wilber, Barbara A. Krueger and Mead C. Killion, J. Acoustic Soc. Am. Suppl. 1, Vol. 81 Spring 1987. GSI determined the transfer data from an IEC 711 coupler to an ANSI HA-1 coupler. Using this data, the reference threshold values were determined for both the Ipsi and Contra insert earphones for calibration in an ANSI HA-1 2cc coupler.

Noise Stimulus: The transfer of reference threshold values was done by GSI using the “Threshold Determination Method.” The transfer data from an IEC 711 to an ANSI HA- 1 coupler was determined by GSI.

Intensity levels are reduced as a function of volume at a rate of 1 dB SPL for each .1 ml. Intensity reduction begins at 1.2 ml.

Table 3: Upper limit of HL range in Reflex Threshold Mode

		Pure Tone Stimulus (Hz)				Noise Stimulus		
	Probe Tone (Hz)	500	1000	2000	4000	LBN	HBN	BBN
Ipsi pulsed	226	110	110	105	100	95	95	95
Contra pulsed	226	120	120	120	115	115	115	115
Contra steady	226	120	120	120	115	115	115	115

Lower limit of HL range for all stimulus signals (35 dB HL).
Hearing Level Increment: 5.0 dB
Hearing Level Increment Accuracy: ±0.5 dB
Hearing Level Control Linearity: ±1.0 dB

Stimulus Presentation Control

Signal ON/OFF Ratio: >70 dB
OFF mode signal level: <20 dB SPL
Signal To Noise Ratio: >70 dBA
Measured with disabled probe signal and "A" weighting for noise measurement.
Residual noise: <25 dBA SPL
(Stimulus Present switch in OFF position)
Unwanted Acoustic Probe Signals: <60 dBA
Measured while pump is operating and probe tone is disabled. Measure it with "A" weighted filter in "SLOW" Time mode. The noise in normal operating mode will not effect the immittance measurement accuracy.

Signal separation between Ipsi and Contra channels; all frequencies: >70 dB
(Measured at the probes with the "ON" channel set to 90 dB)
Leaked signal: <20 dB SPL

The radiated acoustic noise from the instrument (with reflex stim off) when measured at 1 meter from the instrument, shall be: <50 dBA
("A" weighting and "SLOW" averaging)

Temporal Specifications of Stimulus Presentation

Steady State Stimulus
Initial Delay (elapsed time from present bar activation to 10% stimulus amplitude): < 100 msec

Terminal Delay (elapsed time from present bar deactivation to 90% stimulus amplitude): <100 msec
Rise time: 7.5 ± 2.5 msec
Fall time: 7.5 ± 2.5 msec

Multiplexed Stimulus *(Used in Reflex Threshold test mode)*

Period data for frequencies: 250 and 500 Hz:

Period	124msec
Stimulus on time	44 msec
Stimulus off time	62 msec
Rise and fall time	18 msec

Period data for all other frequencies:

Period	115 msec
Stimulus on time	44 msec
Stimulus off time	53 msec
Rise and fall time	18 msec

Temporal Spec. Accuracy: ±10% or 5 msec, whichever is greater

Environmental

The GSI TympStar Version 1 meets ANSI S3.6-1996 Standards for temperature and humidity specifications, and it meets the UL 2601-1, CSA 22.2 and IEC60601-1 standards for safety.

Temperature:
Storage: -40 degrees C to +75 degrees C
Operating: +15 degrees C to +35 degrees C
Humidity: 90% at 35 degrees C (non-condensing)

Warm-UpTime

At room temperature; +15°C to +35°C: 10 Minutes
At room temperature; below +15°C: 1 Hour

Calibration Stability

All GSI TympStar Version 1 specifications are met over the range of specified power line, temperature and humidity variations.

Power Line:

Voltage Variation: ±10%

Frequency Variation: ± 5%

Power line short term variation which affects the performance of the instrument will turn off all probe and stimulus signals.

Power Rating:	120 Watts maximum
Line Voltage Range:	100 VAC to 240 VAC
Power Line Frequency Range:	50 - 60 Hz
Temperature Operating Range:	+15°C to +35°C
Relative Humidity Operating Limit:	90%
Guaranteed Operating Elevation:	6000 Ft. (1800m)

Connectors

STIMULUS: External Stimulus Input
(Phone Jack) Peak Voltage: 3 VAC
Input Impedance: 15,000 Ohms

PRESENT: External Present Control Input that turns the stimulus signal ON and OFF (Phone Jack).
Voltage Range: STIM OFF: +5.0 VDC
STIM ON: 0.0 v
Input Impedance: 11,000 Ohms

Contra PHONE: Output Voltage: 7 VAC
Output Impedance: 2.5 Ohms

Standard 9-pin RS232C serial port for interfacing with outside computer.

Pin	Function	Signal level	Impedance
2	RXD	+/- 8 VDC output	300 Ohm
8	CTS	+/- 8 VDC output	300 Ohm
3	TXD	+/- 30 VDC input	5 KOhm
7	RTS	+/- 30 VDC input	5 KOhm
5	SIG_GND	Signal Ground	0 Ohm
1,4,6,9	Unused		

Standard VGAport for external monitor.

Pin	Function	Signal level
1	Red	0.7 Vp-p output
2	Green	0.7 Vp-p output
3	Blue	0.7 Vp-p output
5,6,7,8, 10	Ground	Ground
13	Horizontal Sync	5 Vp-p, 30kHz to 80kHz
14	Vertical Sync	5 Vp-p, 55Hz to 90 Hz
4,9,11, 12,15	Unused	

Standard PS-2 keyboard port for external Keyboard.

Pin	Function	Signal level	Impedance
1	KB data	+ 5 VDC input	5 KOhm
2	MS data	+ 5 VDC input	5 KOhm
3	Ground		0 Ohm
4	Vcc	+ 5 VDC output	5 KOhm
5	KB clock	+ 5 Vp-p, square wave output	50 Ohm
6	MS clock	+ 5 Vp-p square wave output	50 Ohm

Standard parallel printer port for external printer.

Pin	Function	Signal level	Impedance
1	/STROBE	+5 VDC output	45 Ohm
2	D0	+5 VDC output	45 Ohm
3	D1	+5 VDC output	45 Ohm
4	D2	+5 VDC output	45 Ohm
5	D3	+5 VDC output	45 Ohm
6	D4	+5 VDC output	45 Ohm
7	D5	+5 VDC output	45 Ohm
8	D6	+5 VDC output	45 Ohm
9	D7	+5 VDC output	45 Ohm
10	/ACK	+5 VDC input	1.65 KOhm
11	BUSY	+5 VDC input	1.65 KOhm
12	PAPER EMPTY	+5 VDC input	1.65 KOhm
13	SELECT	+5 VDC input	1.65 KOhm
14	/AUTOLF	+5 VDC output	45 Ohm
15	/ERROR	+5 VDC input	1.65 KOhm
16	/INIT	+5 VDC output	45 Ohm
17	/SEL IN	+5 VDC output	45 Ohm
18,19, 20,21,22 23,24,25	Ground	Ground	0 Ohm

Electrical

The following apply to the TympStar system:

1) Class 1 Medical Equipment

2) Type B Medical Equipment 

3) IPXO ingress of water (ordinary equipment)

4) Equipment not suitable for use in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide.

5) Mode of operation - continuous

Input Voltage: 100 – 240 VAC
Input Frequency: 50 – 60 Hz
Input Current: 3.2 A maximum
Power Consumption: 120W maximum

Supplied Accessories

Contra insert phone	GSI Part # 8000-0078
Calibration cavity (V1)	GSI Part # 2000-1036
Probe cleaning kit (2 boxes)	GSI Part # 2000-9610
Eartips:	
1 pkg. 8 standard sizes, 4 ea. (Color coded)	GSI Part # 1700-9660
1 pkg. 6 special sizes, 2 ea.	GSI Part # 1700-9670
1 pkg. 6 screening sizes, 2 ea.	GSI Part # 1700-9622
User Manual	GSI Part # 2000-0100
Quick Reference Guide	GSI Part # 2000-0108
Printer paper (2 rolls) for orders including printer	GSI Part # 1700-9619
Spare set of probe tubing	GSI Part # 2000-9617
Probe mount - shoulder	GSI Part # 1700-9646
Probe mount - wrist	GSI Part # 1700-9642
Probe mount - clothes	GSI Part # 1700-9608
Printer paper, adhesive-backed for orders including a printer	GSI Part # 1770-9643
GSI TympStar dustcover	GSI Part # 1700-9618
Power cord with hospital-grade plug	GSI Part # 4204-0251 (USA)

Power cord part # varies depending on location

Mechanical

DIMENSIONS AND WEIGHT
W x D x H: 20.38 inches x 15 inches x 12.6 inches (LCD raised)
52cm x 38cm x 32cm
Height with LCD lowered - 6 inches (15cm)
Weight: 16.58 pounds, 7.53 kg
Shipping weight: 29.50 pounds, 13.38 kg

Materials of manufacture

Top Case, LCD Housing

Front & Rear & Hinges:	Lexan 500 w/10% Glass & 2% Blowing Agent, UL 94V0 Rated
LCD Lense:	GE HP40S -OR- Duralan II
Switches:	Shincor Shin-Etsu/Novacor KE-951 U
Labels:	Lexan & Polycarbonate
Softkey Panel:	Mylar
Probe Cord:	Polyvinyl Chloride (PVC)
Probe Top & Bottom Housings:	Cycolac KJW, UL 94V0 Rated
Probe Tip:	Polypropolene
Eartips:	Kraton 3226
Tubing:	Vinyl and Polyurethane

Calibration requirements

GSI recommends quarterly calibration checks for the GSI TympStar along with annual certification. ASHA requires quarterly electro-acoustic calibration checks and annual electro-acoustic calibration. It is good practice to perform daily biologic checks. See Chapter 4: Calibration for complete calibration instructions.

Version 2 Specifications

Standards

The GSI TympStar Version 2 meets or exceeds the following standards and specifications for aural acoustic admittance instruments:
IEC 1027 1991-03
ANSI S3.39-1987
ANSI S3.6-1996
ANSI S3.7-1995
IEC 645-1 1992
IEC 126-1973 (also BS 6111-1981)
BS ISO 389-2- 1994

Y2K Compliant
UL 2601-1 Part 1: General Requirements for Safety
CSA C22.2 No. 601.1-M90 (Canada)
CE 0344 CE Mark per Medical Device Directive (93/42/EEC)

EN60601-1:1990 Safety Requirements for Medical Electrical Equipment
EN60601-1-2 Medical Electrical Equipment Emissions and Immunity Requirements

This equipment has been tested for radio frequency emissions and has been verified to meet Radiated and Conducted Emissions per EN 55011-1998, Group 1, Class A and per CISPR, Class A.

Sensitivity ranges

The following admittance measurements give maximum range at standard probe tone frequencies. Compliance "Y", 226 Hz is measured in ml. All other units are in mmhos. (1 acoustic mmho = 10^{-8} $m^{3)}$ /Pa.s)

Table 1: Tymp Mode (Y, B, G)

Frequency	Digital Read-Out Including Cursor	Graphical Display
226 Hz	-7.0 to +7.0	-1.0 to +7.0
678 Hz	-21 to + 21	-5.0 to +25
1000 Hz	-30 to +30	-5.0 to +30

Accuracy:
226Hz: 0.1 ml or 5%, whichever is greater.
Above 226Hz: (F/226) x 0.1 mmho or K% whichever is greater.
K FACTOR: From 250 to 1500 Hz = 5%
Above 1500 Hz =10%

Table 2: Reflex Mode (Y, B, G)

Frequency	Digital Read-Out Including Cursor	Graphical Display
226 Hz	-7.0 to +7.0	-0.16 to +0.80 +0.16 to -0.80
678 Hz	-21 to + 21	-0.48 to +0.80 +0.48 to -0.80
1000 Hz	-30 to +30	-0.64 to +0.80 +0.64 to -0.80

Accuracy: 226 Hz is 0.02 ml or 5%,whichever is greater.

Temporal Latency in ARLT Mode

InitialLatencyLi: < 5 ± 5 msec.
(From signal onset to 10% ofAmplitude)
Terminal Latency Lt: < 5 ± 5 msec
(From signal offset to 90% of Amplitude)
Rise Time Tr: <30 ±5 msec.
(From 10% to 90% of Amplitude)
Fall Time Tt: <25 ±5 msec.
(From 90% to 10% of Amplitude)

Multi Frequency

Resonant Frequency Measurement Accuracy: 50 Hz or 5%, whichever is greater

NOTE
Resonant frequency is defined as the frequency at which "Delta B" is zero (B is measured at + 200 daPa and at "Peak Pressure").

Probe Signal (Sinusoidal)

Frequencies:
Discrete: 226 Hz, 678 Hz, 1000 Hz
Multi Freq: From 250 Hz to 2000 Hz
Multi Frequency Increment:50 Hz
Frequency Accuracy:
Discrete and Sweep ±1%
From 250 to 1000 Hz ±1%
Above 1000 Hz ±2%
Harmonic Distortion: <2%
(Measured in an HA-1 2cc Coupler)
Signal Level (In Real Ear and In Normal Test mode):
226 Hz: 85 dB SPL
678 Hz: 80 dB SPL
1000 Hz: 75 dB SPL

NOTE
All Probe Tone levels at all frequencies are set to be nominally 70 dB HL.

Signal Level Accuracy:
226 Hz: ±1.5 dB SPL
Other Frequencies: ±3.0 dB SPL

Pneumatic System

Pressure Maximum Limits: -800 daPa to +600 daPa
Programmed Pressure Ranges:
Normal: + 200 to - 400 daPa
Wide: + 400 to - 600 daPa
Pressure Accuracy: ±10% or ±10 daPa, Whichever is greater in cavities from 0.5 cc to 5.0 cc.
Pressure Sweep Rate: 12.5 daPa/sec
50 daPa/sec
600/200 daPa/sec
200 daPa/sec
Manual Sweep Rate Limit: 600 daPa/sec
Sweep Rate Accuracy: ±10%
Pressure System Leak Rate: < 1. 0 daPa/sec
(Measured at -600 and +400 daPa, while pressure servo is disabled.)

Acoustic Reflex Activating (Stimulus) Signal

Pure Tone Stimulus

Frequencies for Contra phone and for Ipsi phone with time multiplexed stimulus. See Table 3.

Frequency Accuracy: ±3%
Total Harmonic Distortion :
< 5% at 500 Hz, 85dBHL
< 5% at 1000Hz - 3000Hz, 100dBHL
< 5% at 4000Hz, 75dBHL
< 10% at the maximum dBHL settings

Reference:
ANSIS3.39-1987
Section 7.5.2.2 Frequency Accuracy
Section 7.5.2.3 Harmonic Distortion

Noise Stimulus

The uniformity of the spectrum level of acoustic pressure for the noise signal over 20 averages measured acoustically within their respective band limits will be:
±10 dB for insert or probe type earphones
±5 dB for supra-aural type earphones
Noise Band Widths:
Low Band: 125 -1600 Hz
High Band: 1600 - 4000 Hz
Broad Band: 125 - 4000 Hz (Relative to level at 1 kHz)
Band-edges accurate to within ±15%
Roll off rate: >12 dB/Octave

Stimulus Level Control

Tone Stimulus: The transfer of reference equivalent threshold values are based on the article; “Reference Threshold Levels For The ER-3A Insert Phone,” by Laura Ann Wilber, Barbara A. Krueger and Mead C. Killion, J. Acoustic Soc. Am. Suppl. 1, Vol. 81 Spring 1987. GSI determined the transfer data from an IEC 711 coupler to an ANSI HA-1 coupler. Using this data, the reference threshold values were determined for both the Ipsi and Contra insert earphones for calibration in an ANSI HA-1 2cc coupler.

Noise Stimulus: The transfer of reference threshold values was done by GSI using the “Threshold Determination Method.” The transfer data from an IEC 711 to an ANSI HA- 1 coupler was determined by GSI.

Intensity levels are reduced as a function of volume at a rate of 1 dB SPL for each .1 ml. Intensity reduction begins at 1.2 ml.

Table 3A: Upper limit of HL range in Reflex Threshold Mode

		PureTone Stimulus (Hz)					Noise Stimulus			Other Stimulus	
	Probe Tone	250	500	1000	2000	4000	LBN	HBN	BBN	Click (SPL)	EXT (SPL)
Ipsi Pulsed	226 Hz	95	110	110	105	100	95	95	95	110	110
	678 Hz	95	110	110	105	100	95	95	95	110	110
	1000 Hz	95	110	110	105	100	95	95	95	110	110
Contra Pulsed	226 Hz	110	120	120	120	115	115	115	115	120	120
	678 Hz	110	120	120	120	115	115	115	115	120	120
	1000 Hz	110	120	120	120	115	115	115	115	120	120
Contra Steady	226 Hz	n/a	120	120	120	115	115	115	115	120	120
	678 Hz	110	n/a	120	120	115	115	115	115	120	120
	1000 Hz	110	120	n/a	120	115	115	115	115	120	120

Lower limit of HL range for all stimulus signals (35 dB HL).
Hearing Level Increment: 1.0, 2.0, 5.0 dB
Hearing Level Increment Accuracy: ±0.5 dB
Hearing Level Control Linearity: ±1.0 dB

Table 3B: Upper limit of HL range in ARLT and Reflex Decay Modes

		Stimulus Selections (Hz)					Noise Stimulus			Other Stimulus	
	Probe Tone	250	500	1000	2000	4000	LBN	HBN	BBN	Click (SPL)	EXT (SPL)
Contra	226Hz ①	n/a	120	120	120	115	115	115	115	120	120
	678Hz ②	110	n/a	120	120	115	115	115	115	120	120
Ipsi	226Hz ①	n/a	105	110 ③	105	100	n/a	n/a	n/a	n/a	110
	678Hz ②	90	n/a	110	100	100	n/a	n/a	n/a	n/a	110

①Limits apply for Reflex Decay and ARLT modes.
②Limits apply for Reflex Decay only. ARLT not available at 678 Hz.
③Limits apply for Reflex Decay only. ARLT limit is 105 dB.

TABLE 4: UPPER HL LIMIT IN ACOUSTIC REFLEX SENSITIZATION MODE

C_f Versus l_a

Ipsi Actuator		Cf (Contra facilitator)						
(Hz)	(HL)	500Hz (dbHL)	1000 (dbHL)	2000 (dbHL)	4000 (dbHL)	6000 (dbHL)	BBN (dbHL)	EXT(SPL) (dbSPL)
500	105	---	120	120	115	115	115	120
1000	110	120	---	120	115	115	115	120
2000	105	120	120	---	115	115	115	120
4000	100	120	120	120	---	115	115	120
EXT	101	120	120	120	115	115	115	120

C_f Versus C_a

Contra Actuator		Ct (Contra facilitator)						
(Hz)	(HL)	500Hz (dbHL)	1000 (dbHL)	2000 (dbHL)	4000 (dbHL)	6000 (dbHL)	BBN (dbHL)	EXT(SPL) (dbSPL)
500	120	---	120	120	115	115	115	120
1000	120	120	---	120	115	115	115	120
2000	120	120	120	---	115	115	115	120
4000	115	120	120	120	---	115	115	120
BBN	115	120	120	120	115	115	115	120
EXT	120	120	120	120	115	115	115	120

C_f Versus C_a

Contra Actuator		If (Ipsi facilitator)					
(Hz)	(HL)	500Hz (dbHL)	1000 (dbHL)	2000 (dbHL)	4000 (dbHL)	6000 (dbHL)	EXT(SPL) (dbSPL)
500	120	---	110	105	100	90	110
1000	120	105	---	105	100	90	110
2000	120	105	110	---	100	90	110
4000	115	105	110	105	---	90	110
BBN	115	105	110	105	100	90	110
EXT	120	105	110	105	100	90	110

I_f Versus l_a

Ipsi Actuator		If (Ipsi facilitator)					
(Hz)	(HL)	500Hz (dbHL)	1000 (dbHL)	2000 (dbHL)	4000 (dbHL)	6000 (dbHL)	EXT(SPL) (dbSPL)
500	105	---	110	105	100	90	110
1000	110	105	---	105	100	90	110
2000	105	105	110	---	100	90	110
4000	100	105	110	105	---	90	110
EXT	110	105	110	105	100	90	110

Click Stimulus

Guaranteed Peak Equivalent SPL Levels:
Ipsi: 110 dB SPL
Contra: 120 dB SPL
Peak hold SPL to peak equivalent SPL transfer data.
(Peak hold SPL = peak equivalent SPL + transfer data)
Ipsi: 8.5 dB
Contra: 5.5 dB
Click Rate Range: 50-300 Pulse/sec.
Click rate accuracy: ±1pulse/sec.
Pulse Width (Electrically Measured): 100 msec.
Pulse Rise/Fall Time (Electrically): 5.0 msec.
Frequency Spectrum:
Ipsi: 50 - 4000 Hz
Contra: 50 - 3600 Hz

NOTE
Frequency spectrum uniformity better than: 10 dB

External Input: At 0.5 VRMS:
1 KHz Upper Limits:
Ipsi: 110 dB SPL
Contra: 120 dB SPL

Stimulus Presentation Control

Signal ON/OFF Ratio: >70 dB
OFF mode signal level: <20 dB SPL
Signal To Noise Ratio: >70 dBA
Measured with disabled probe signal and "A" weighting for noise measurement.
Residual noise: <25 dBA SPL
(Stimulus Present switch in OFF position)
Unwanted Acoustic Probe Signals: <60 dBA
Measured while pump is operating and probe tone is disabled. Measure it with "A" weighted filter in "SLOW" time mode. The noise in normal operating mode will not effect the immittance measurement accuracy.

Signal separation between Ipsi and Contra channels; all frequencies: >70 dB
(Measured at the probes with the "ON" channel set to 90 dB)
Leaked signal: <20 dB SPL

The radiated acoustic noise from the instrument (with reflex stim off) when measured at 1 meter from the instrument, shall be: <50 dBA
("A" weighting and "SLOW" averaging)

Temporal Specifications Of Stimulus Presentation

Steady State Stimulus
Initial Delay (elapsed time from present bar activation to 10% stimulus amplitude): < 100 msec

Terminal Delay (elapsed time from present bar deactivation to 90% stimulus amplitude): <100 msec
Rise time: 7.5 ± 2.5 msec
Fall time: 7.5 ± 2.5 msec

NOTE
Initial and terminal delays do not effect temporal measurement of ARLT test (software compensates for them).

Multiplexed Stimulus *(Used in Reflex Threshold test mode)*

Period data for frequencies: 250 and 500 Hz:

Period	124 msec
Stimulus on time	44 msec
Stimulus off time	62 msec
Rise and fall time	18 msec

Period data for all other frequencies:

Period	115 msec
Stimulus on time	44 msec
Stimulus off time	53 msec
Rise and fall time	18 msec

Temporal Spec. Accuracy: ±10% or 5 msec, whichever is greater

Environmental

The GSI TympStar Version 2 meets ANSI S3.6-1996 (Rl986) Standards for temperature and humidity specifications, and it meets the UL 2601 Standards in terms of shock hazards and leakage.

Temperature:
Storage: -40 degrees C to +75 degrees C
Operating: +15 degrees C to +35 degrees C
Humidity: 90% at 35 degrees C (non-condensing)

Warm-UpTime

At room temperature; +15°C to +35°C: 10 Minutes
At room temperature; below +15°C: 1 Hour

Calibration Stability

All GSITympStarVersion 2 specifications are met over the range of specified power line, temperature and humidity variations.

Power Line:

Voltage Variation: ±10%

Frequency Variation: ± 5%

Power line short term variation which affects the performance of the instrument will turn off all probe and stimulus signals.

Power Rating:	120 Watts maximum
Line Voltage Range:	100 VAC to 240 VAC
Power Line Frequency Range:	50 - 60 Hz
Temperature Operating Range:	+15°C to +35°C
Relative Humidity Operating Limit:	90%
Guaranteed Operating Elevation:	6000 Ft. (1800m)

Connectors

STIMULUS: External Stimulus Input
(Phone Jack) Peak Voltage: 3 VAC
Input Impedance: 15,000 Ohms

PRESENT: External Present Control Input that turns the stimulus signal ON and OFF (Phone Jack).
Voltage Range: STIM OFF: +5.0 VDC
STIM ON: 0.0 v
Input Impedance: 11,000 Ohms

Contra PHONE: Output Voltage: 7 VAC
Output Impedance: 2.5 Ohms

Standard 9-pin RS232C serial port for interfacing with outside computer.

Pin	Function	Signal level	Impedance
2	RXD	+/- 8 VDC output	300 Ohm
8	CTS	+/- 8 VDC output	300 Ohm
3	TXD	+/- 30 VDC input	5 KOhm
7	RTS	+/- 30 VDC input	5 KOhm
5	SIG_GND	Signal Ground	0 Ohm
1,4,6,9	Unused		

Standard VGAport for external monitor.

Pin	Function	Signal level
1	Red	0.7 Vp-p output
2	Green	0.7 Vp-p output
3	Blue	0.7 Vp-p output
5,6,7,8, 10	Ground	Ground
13	Horizontal Sync	5 Vp-p, 30kHz to 80kHz
14	Vertical Sync	5 Vp-p, 55Hz to 90 Hz
4,9,11, 12,15	Unused	

Standard PS-2 keyboard port for external Keyboard.

Pin	Function	Signal level	Impedance
1	KB data	+ 5 VDC input	5 KOhm
2	MS data	+ 5 VDC input	5 KOhm
3	Ground		0 Ohm
4	Vcc	+ 5 VDC output	5 KOhm
5	KB clock	+ 5 Vp-p, square wave output	50 Ohm
6	MS clock	+ 5 Vp-p square wave output	50 Ohm

Standard parallel printer port for external printer.

Pin	Function	Signal level	Impedance
1	/STROBE	+5 VDC output	45 Ohm
2	D0	+5 VDC output	45 Ohm
3	D1	+5 VDC output	45 Ohm
4	D2	+5 VDC output	45 Ohm
5	D3	+5 VDC output	45 Ohm
6	D4	+5 VDC output	45 Ohm
7	D5	+5 VDC output	45 Ohm
8	D6	+5 VDC output	45 Ohm
9	D7	+5 VDC output	45 Ohm
10	/ACK	+5 VDC input	1.65 KOhm
11	BUSY	+5 VDC input	1.65 KOhm
12	PAPER EMPTY	+5 VDC input	1.65 KOhm
13	SELECT	+5 VDC input	1.65 KOhm
14	/AUTOLF	+5 VDC output	45 Ohm
15	/ERROR	+5 VDC input	1.65 KOhm
16	/INIT	+5 VDC output	45 Ohm
17	/SEL IN	+5 VDC output	45 Ohm
18,19, 20,21,22 23,24,25	Ground	Ground	0 Ohm

Electrical

The following apply to theTympStar system:

1) Class 1 Medical Equipment

2) Type B Medical Equipment 

3) IPXO ingress of water (ordinary equipment)

4) Equipment not suitable for use in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide.

5) Mode of operation - continuous

Input Voltage: 100 – 240 VAC
Input Frequency: 50 – 60 Hz
Input Current: 3.2 A maximum
Power Consumption: 120W maximum

Supplied Accessories

Contra insert phone	GSI Part # 8000-0078
Calibration cavity (V2)	GSI Part # 2000-1035
Probe cleaning wire (2 boxes)	GSI Part # 2000-9610
Eartips:	
1 pkg. 8 standard sizes, 4 ea. (Color coded)	GSI Part # 1700-9660
1 pkg. 6 special sizes, 2 ea.	GSI Part # 1700-9670
1 pkg. 6 screening sizes, 2 ea.	GSI Part # 1700-9622
User Manual	GSI Part # 2000-0120
Quick Reference Guide	GSI Part # 2000-0126
Printer paper (2 rolls) for orders including printer	GSI Part # 1738-9619
Spare set of probe tubing	GSI Part # 2000-9617
Probe mount - shoulder	GSI Part # 1700-9646
Probe mount - wrist	GSI Part # 1700-9642
Probe mount - clothes	GSI Part # 1700-9608
Printer paper, adhesive-backed for orders including a printer	GSI Part # 1770-9643
GSI TympStar dustcover	GSI Part # 1700-9618
Power cord with hospital-grade plug	GSI Part # 4204-0251 (USA)

Power cord part # varies depending on location

Mechanical

DIMENSIONS AND WEIGHT
W x D x H: 20.38 inches x 15 inches x 12.6 inches (LCD raised)
52cm x 38cm x 32cm
Height with LCD lowered - 6 inches (15cm)
Weight: 16.58 pounds, 7.53 kg
Shipping weight: 29.50 pounds, 13.38 kg

Materials of manufacture

Top Case, LCD Housing	
Front & Rear & Hinges:	Lexan 500 w/10% Glass & 2% Blowing Agent, UL 94V0 Rated
LCD Lense:	GE HP40S -OR- Duralan II
Switches:	Shincor Shin-Etsu/Novacor KE-951 U
Labels:	Lexan & Polycarbonate
Softkey Panel:	Mylar
Probe Cord:	Polyvinyl Chloride (PVC)
Probe Top & Bottom Housings:	Cycolac KJW, UL 94V0 Rated
Probe Tip:	Polypropolene
Eartips:	Kraton 3226
Tubing:	Vinyl and Polyurethane

Calibration requirements

GSI recommends quarterly calibration checks for the GSI TympStar along with annual certification. ASHA requires quarterly electro-acoustic calibration checks and annual electro-acoustic calibration. It is good practice to perform daily biologic checks. See Chapter 4: Calibration for complete calibration instructions.

Operation 3

This chapter summarizes the operation of the TympStar Version 1 and TympStar Version 2 Middle-ear Analyzers. A brief introduction to the TympStar controls, menus and LCD screens will be followed by summarized test procedures for each instrument. Please refer to the Reference Instruction Manuals for more detailed operating instructions.

NOTE

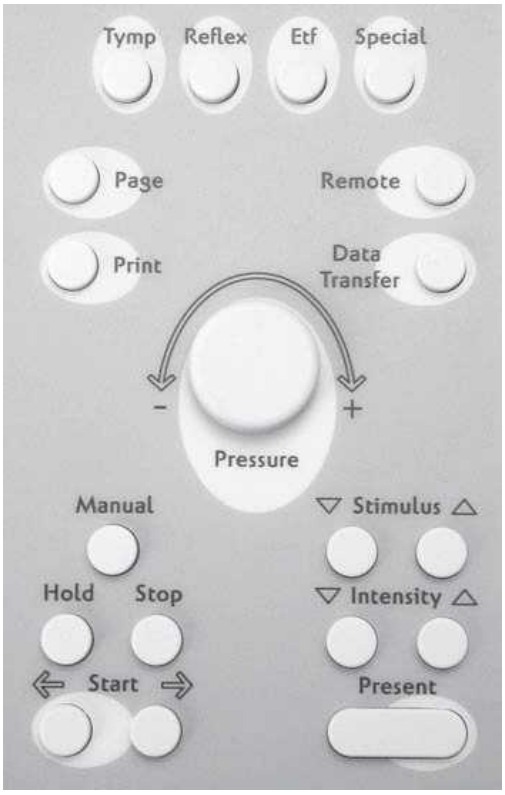
Most generic LCD screen and menu examples use TympStar Version 2 images. However, the concepts and processes described apply equally well to both instruments.

Front panel controls

Front panel controls consist of a combination of "hardkeys" with fixed functions that do not change, and "softkeys" located under the LCD that change to support the changing requirements of a test session. A rotary pressure control is provided to change or fine-tune pressure within the ear canal.

Hardkeys

All of the push-button controls on the front panel are hardkeys. Three hardkeys are also located on the left and right sides of the LCD housing. Their functions are printed directly on the push-button or nearby on the panel and do not change. The front panel hardkey functions include:



Tymp — Causes GSI (or operator programmed) default criteria for diagnostic tymp test to be automatically initialized.

Reflex — Causes GSI (or operator programmed) default criteria for reflex threshold testing to be automatically initialized.

Etf — Causes GSI (or operator programmed) default criteria for eustachian tube function (intact eardrum) test to be automatically initialized.

Special — Causes GSI TympStar to initialize to GSI (or operator programmed) default criteria for reflex decay test.

Page — Allows operator to recall and display tests in memory or in progress.

Print — Allows operator to print selected test results.

Remote — Used when GSI TympStar is interfaced with external computer. Implements a common handshake routine to ensure that the RS232 link is in place.

Data Transfer — Used to send test data to an external computer.

Pressure control — Rotary knob used to manually change or fine-tune the pressure within the ear canal.

Manual — Allows the user to run each applicable test procedure manually. The pressure control is used to change pressure manually within the ear canal.

Hold — Allows the current test sequence to be temporarily halted without venting the ear canal pressure.

Stop — Allows the current test sequence to be terminated. The ear canal is vented. Data on the current page is stored in memory.

Start — Causes the selected test sequence to begin in the direction indicated by the associated arrow.

Stimulus — Allows available stimuli to be scrolled up or down and selected. This feature is available only for Reflex type tests.

Intensity — Allows operator to select and set desired intensity (dB HL). This feature is available only for Reflex type tests.

Present — Allows selected stimulus to be presented either manually or according to preset automatic timing. This feature is available only for Reflex type tests.

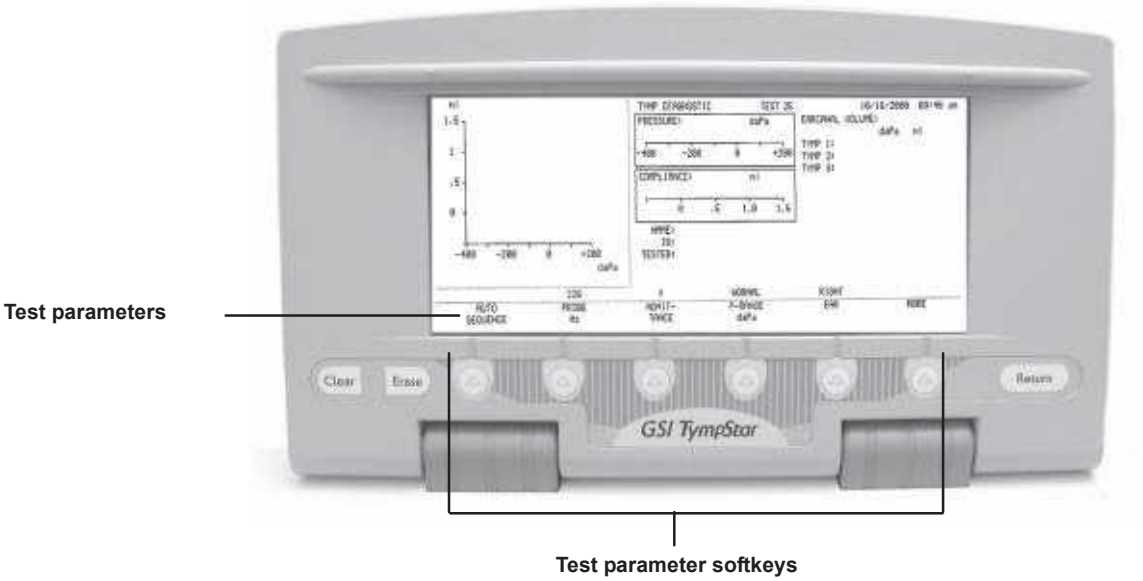
LCD hardkeys — Three hardkeys are also located on the left and right sides of the LCD housing. Their functions are printed directly on the push-button and do not change. The LCD housing hardkey functions include:

Clear — Deletes selected tests stored in memory.

Erase — Erases current display of test results prior to placing test results in memory.

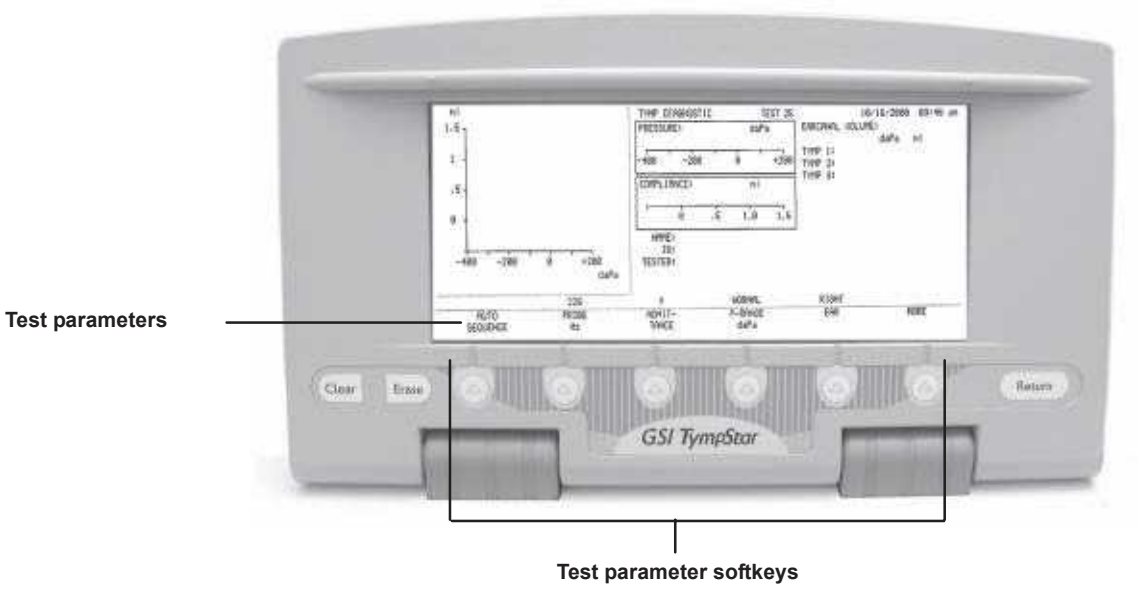
Return — Allows the operator to go back to the next higher level in the softkey menu. Depressing Return while in Clear, Page, or Print mode restores the instrument to the mode previously selected.

Softkeys — The push-buttons located directly under the LCD are the only softkeys. Their functions are displayed on the LCD and change in support of the current test activities.



Menus and LCD screens

Hardkeys are located on the front panel and the sides of the LCD panel and provide fixed functions that do not change, such as selection of test type. Softkeys located directly under the LCD change to support the requirements of each test session.

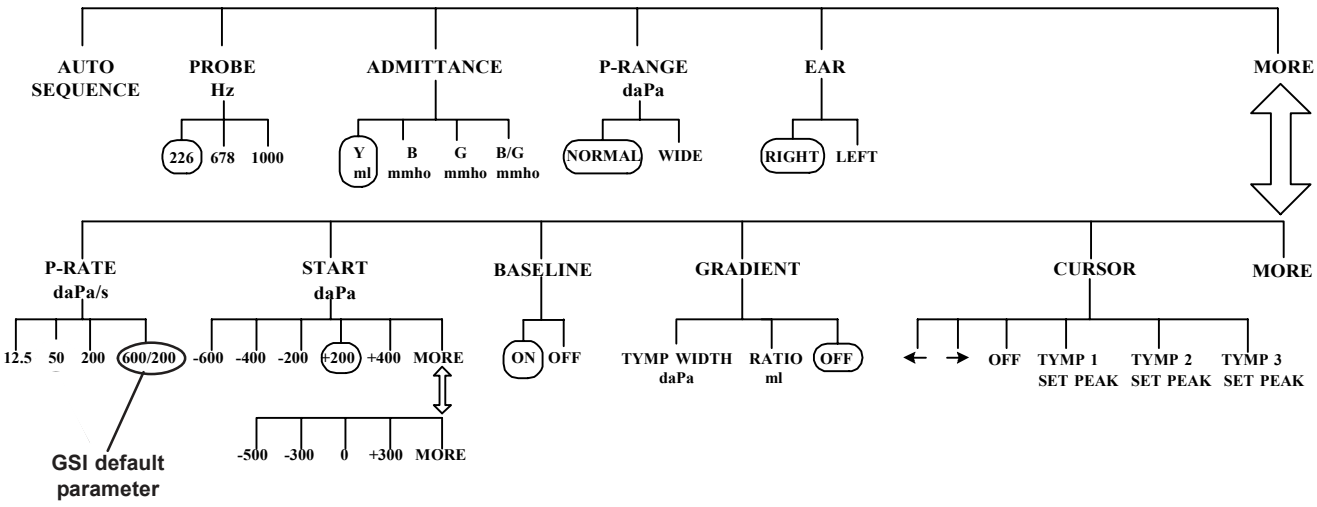


Menus

Selecting a test mode by pressing a hardkey, causes the required test screen to be displayed with the appropriate menu of test parameters shown across the bottom of the LCD. The softkeys are then used in conjunction with hardkeys to navigate through menus and set parameter values for the selected tests. For example, pressing the TYMPhardkey causes the Tymp Diagnostic screen to be displayed.

GSI-developed default parameters for each selected test are displayed on the lower portion of the LCD above the six softkeys. Alternative choices may be made by pressing the appropriate test parameter softkey.

Pressing a test parameter softkey causes a new menu of choices to be presented across the bottom of the screen for that function. The menu structure for the TympStar Version 2 Tymp diagnostic functions is diagrammed on the next page as an example.



The MORE softkey is used to toggle between the top and lower levels of menus while the test screen portion above the softkeys remains unchanged.

NOTE
The GSI default parameters are circled on the menu structure diagrams.

Program modes

All test modes allow the user to individually program a unique set of default test parameters. User-programmed parameters override GSI-developed default parameters.

Version 1 probe tone frequencies

The TympStar Version 1 measures compliance using a 226 Hz probe tone.

Version 2 probe tone frequencies

The following probe tone frequencies are available:

- 226 Hz - All Tests
- 678 Hz - Tymp Diagnostic, Reflex Threshold, Reflex Decay, ETF
- 1000 Hz - Tymp Diagnostic, Reflex Threshold, ETF
- 250 Hz - 2000 Hz Sweep - Multiple Frequency Tympanometry

Version 1 LCD graphic traces

The TympStar Version 1 measures compliance, and shows the tracing on the graphic display as a solid line.

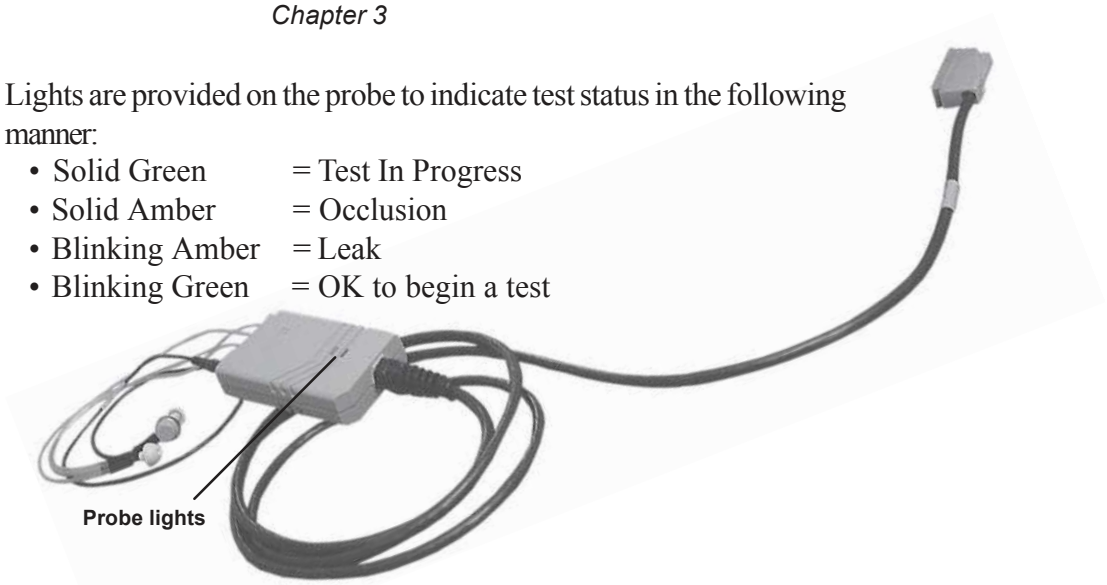
Version 2 LCD graphic traces

The TympStar Version 2 measures admittance (Y), and its components: Susceptance (B) and Conductance (G). Admittance (Y) and Susceptance (B) tracings are solid lines, while tracings of conductance (G) values are dotted lines.

Probe lights

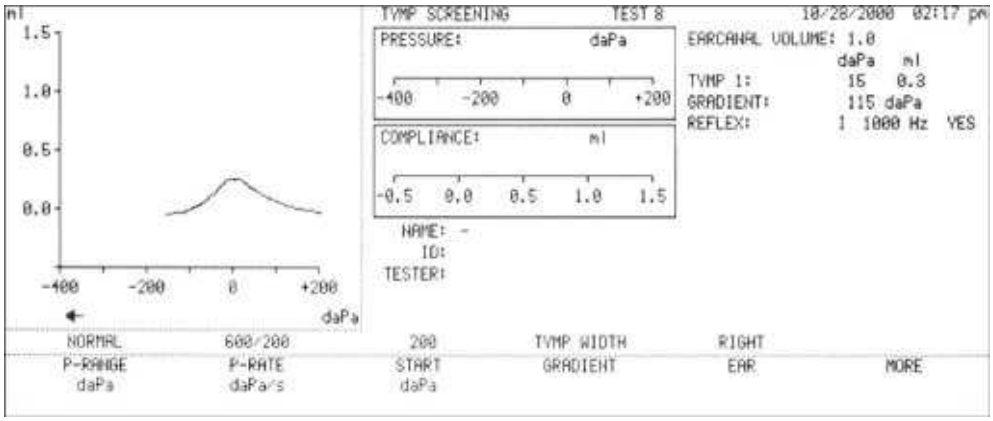
Lights are provided on the probe to indicate test status in the following manner:

- Solid Green = Test In Progress
- Solid Amber = Occlusion
- Blinking Amber = Leak
- Blinking Green = OK to begin a test

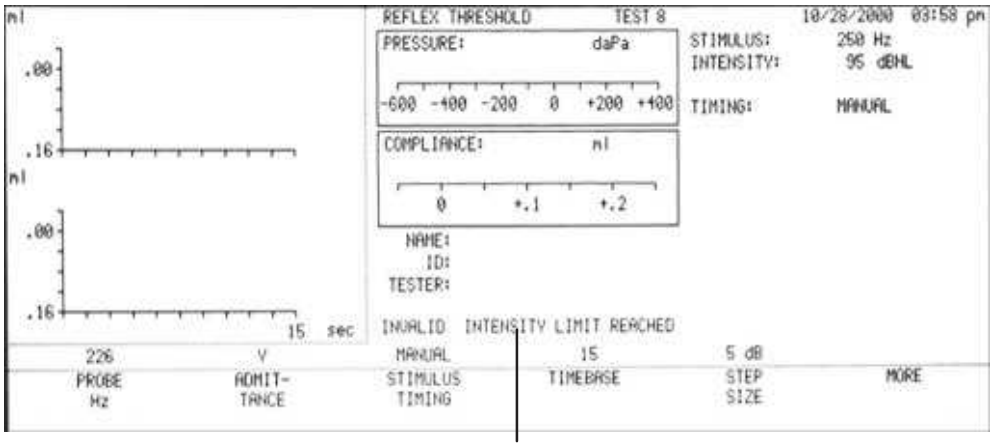


LCD screen

The liquid crystal display (LCD) shows axes for the graphic display of the selected test, and pressure and compliance or admittance meters.



THE TEST STATUS line to the right of the graphics area of screen displays alert messages, invalid selections, and other messages to user.

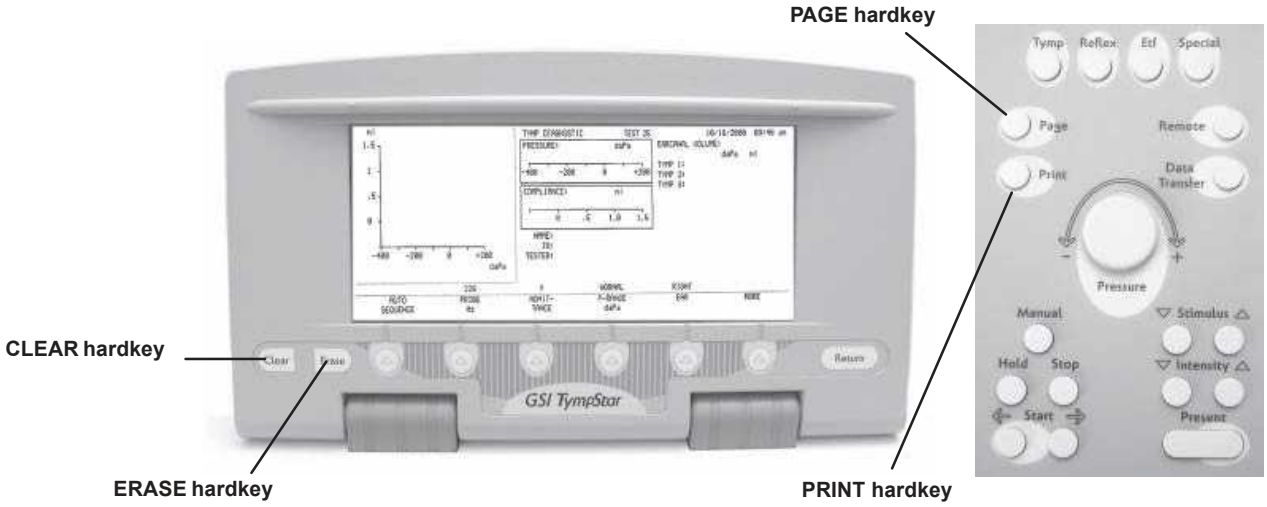


Test Status Line

Test tracings, meter displays with digital readouts, and ear canal volume are recorded in real time.

Erasing and clearing test data

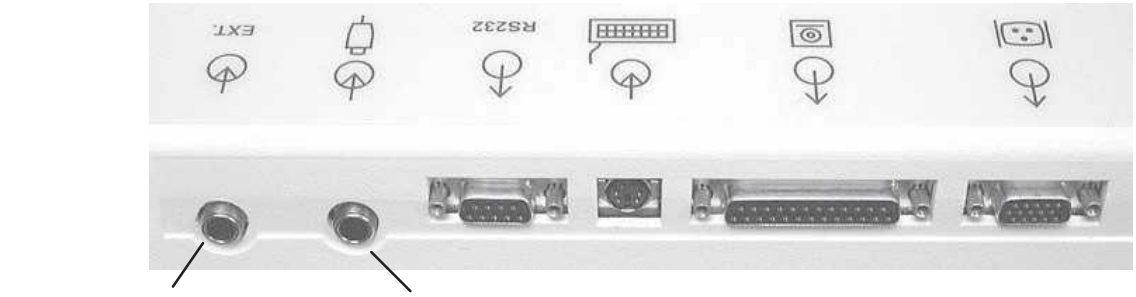
The display of current test data may be erased prior to stopping a test or continuing to the next test by pressing the ERASE hardkey. Previous test data can be selectively cleared from the instrument's storage by selecting the desired test with the PAGE hardkey, then pressing the CLEAR hardkey



It is suggested that all testing be completed on one ear before proceeding to the other ear. Changing the test ear causes a new page of test data to be generated.

Version 2 External reflex test stimuli

Reflex test stimuli may be input from an external source and presented via external control. The connections for these external inputs are provided on the rear panel of the Version 2 instrument. These jacks are unused in the TympStar Version 1.

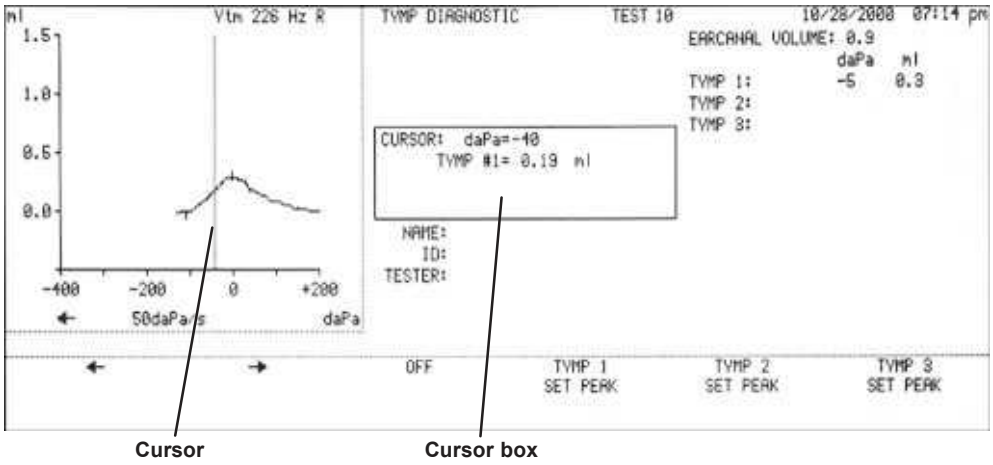


Paging test data

Up to 26 test screens can be stored in memory as "pages." These pages of data can be recalled with appropriate titles and labels for viewing by pressing the PAGE hardkey, then scrolling through pages using up/down arrows. Each screen of data equals a page.

Version 2 cursor

A cursor is available in the TympStar Version 2 on all test data pages for scrolling left or right on the graphics area and can be used to set or reset tymp peak values for tests. A cursor box describes the numeric position of the cursor on both the X and Y axes. Cursors are not available in the Version 1.



NOTE

NOTE
The cursor must be used to set tymp values when testing at anything other than 226Hz, Y in the Version 2.

Printing tests

Up to 26 test screens stored in memory can be printed by selecting PAGE-ALL followed by PRINT. Individual test results can be printed by selecting PAGE and then using the arrow key to display the test. To begin printing, press the PRINT hardkey.

Preparing an external printer

The TympStar supports the full line of Hewlett Packard DeskJet® and LaserJet® printers. These printers provide full sheet printouts of test data. A test printout of results containing:

- One left and right tympanogram graph
- A reflex threshold table for both left and right (Ipsi or Contra only)
- A reflex decay table for both left and right (Ipsi or Contra only)

will print on one 8.5 x 11 inch sheet of paper.

1) Turn the TympStar and printer off, then attach the printer data cable to the printer connector on the rear of the TympStar. Connect the printer power cable to AC power.

WARNING!

WARNING
ANY EQUIPMENT CONNECTED TO THE GSI TYMPSTAR AND USED IN THE PATIENT VICINITY MUST BE POWERED BYAN ISOLATED POWER SOURCE TO MAINTAIN THE ELECTRICAL SAFETY OF THE OVERALL SYSTEM. The isolated power source can be purchased directly from GSI, or elsewhere when approved for use by GSI.

2) Turn the TympStar and printer on. Anytime the external printer is connected and turned on, the TympStar will automatically direct printing to the external printer. To redirect printing to the internal printer, turn the external printer off or disconnect it.

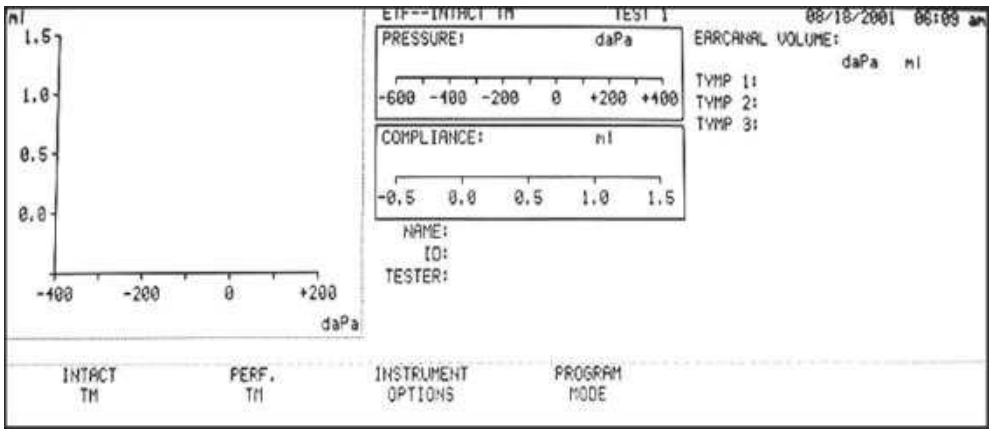
Setting the printer parameters

To set the external printer parameters:

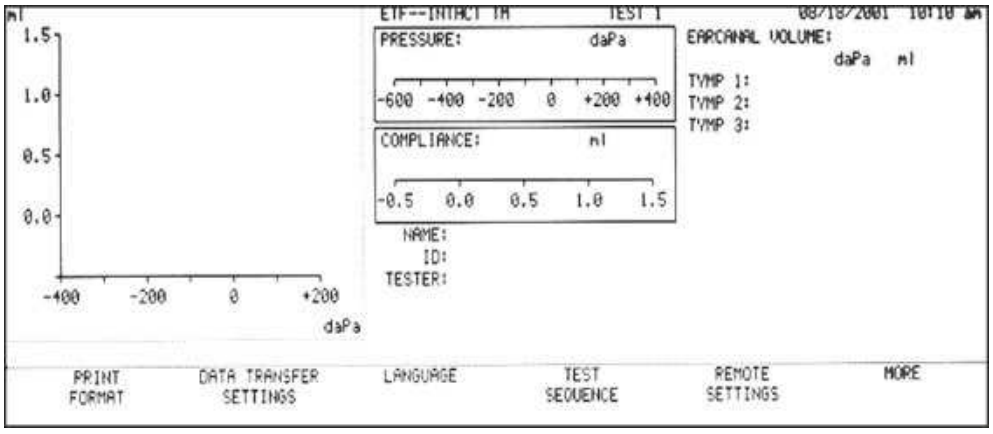
1) Press the ETF hardkey to select the ETF test mode, then press the RETURN hardkey to display the ETF sub-menu.

2) Press the INSTRUMENT OPTIONS softkey, then the MORE softkey to display the PRINT FORMAT softkey selection.

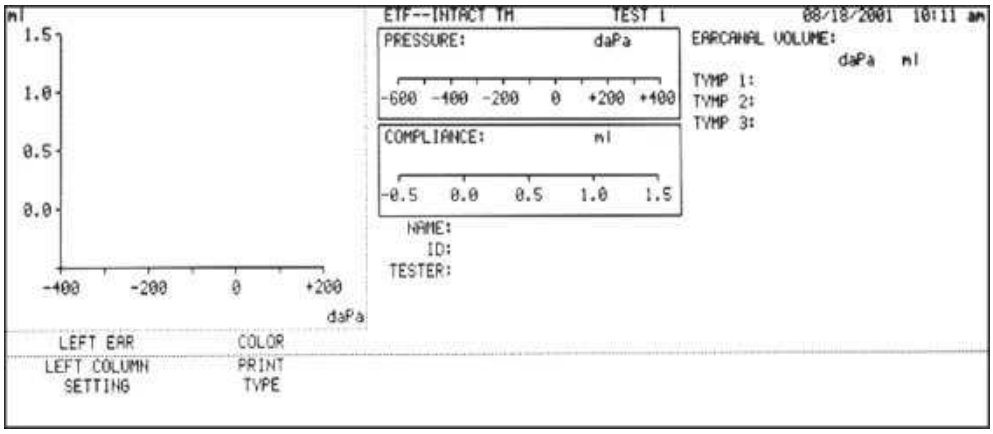
INTACT TM **PERF TM** **INSTRUMENT OPTIONS** **PROGRAM MODE**



3) Press the PRINT FORMAT softkey, and then the MORE softkey to display the EXTERNAL PRINTER SETUP softkey selection.

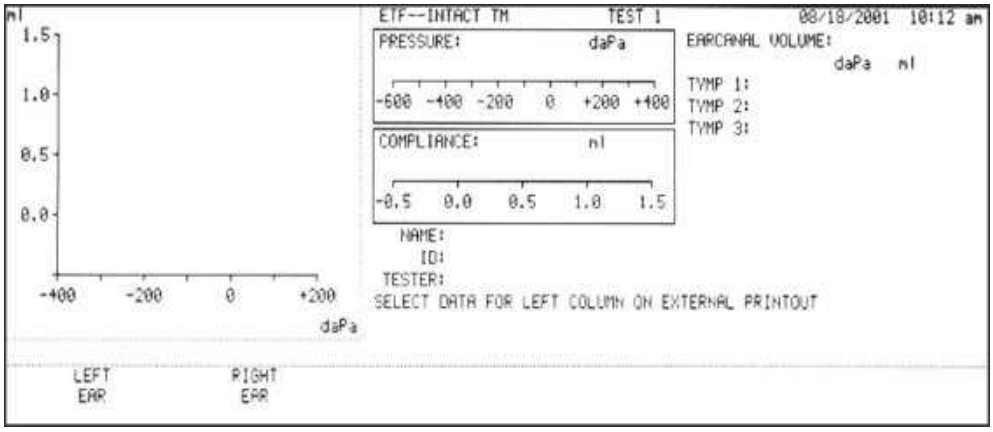


4) Press the EXTERNAL PRINTER SETUP softkey to display the External Printer Setup Menu.



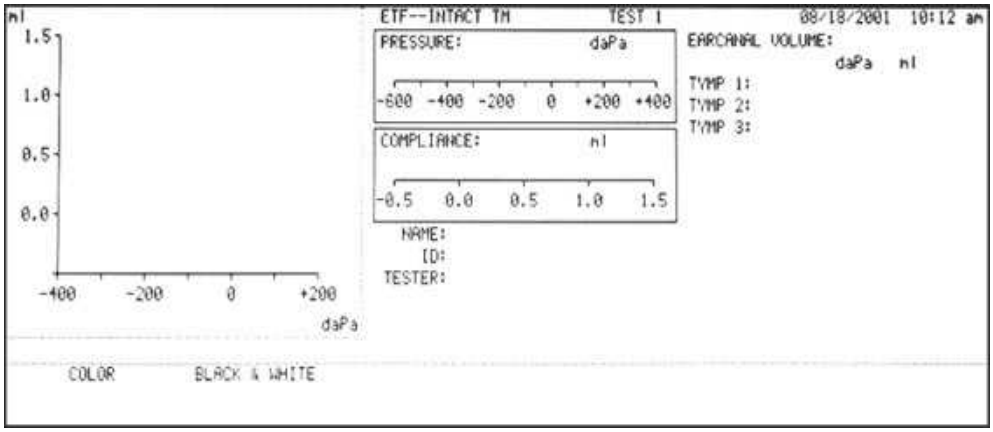
Left column printout data

5) Press the LEFT COLUMN SETTING softkey of the External Printer Setup Menu to set the left column of the printed data to the left or right ear.



Color or black and white

6) Press the PRINT TYPE softkey of the External Printer Setup Menu to set the printout to Black and White or Color.



NOTE

NOTE
The setting must be Black and White for grayscale printers.

Changing Instrument Versions

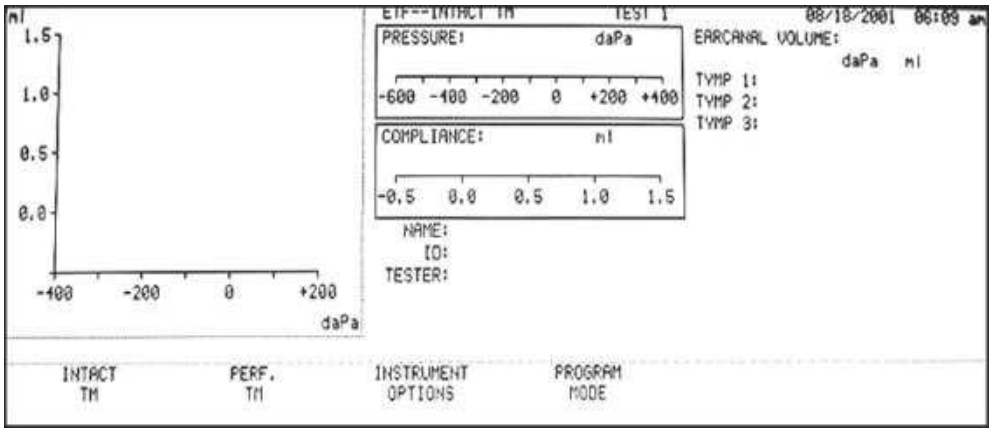
Changing from a Version 2 to a Version 1

The Version function provides an easy way for a TympStar Version 2 to be changed to a Version 1 instrument either temporarily or permanently. Version 1 functionality is a limited subset of Version 2 functionality and does not include 678 and 1000 Hz probe tones, multi-frequency tympanometry or ARLT testing.

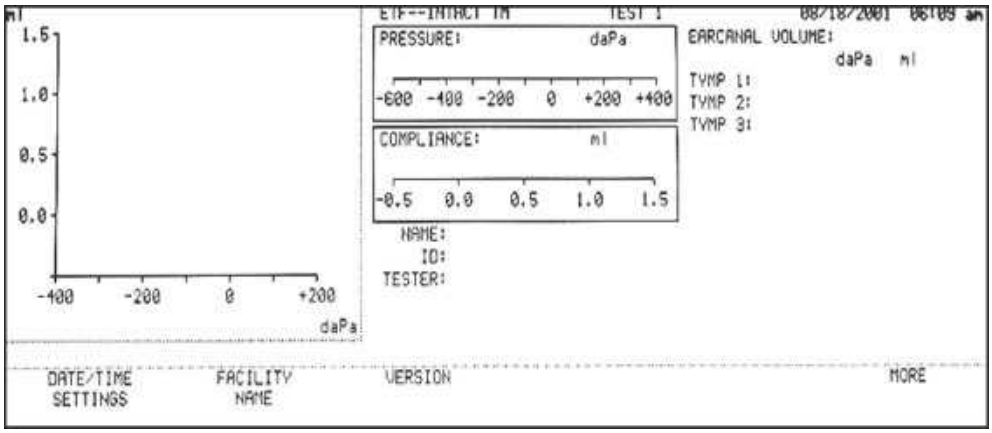
To change from a TympStar Version 2 to a Version 1:

1) Press the ETF hardkey to select the ETF test mode, then press the RETURN hardkey to display the ETF submenu.

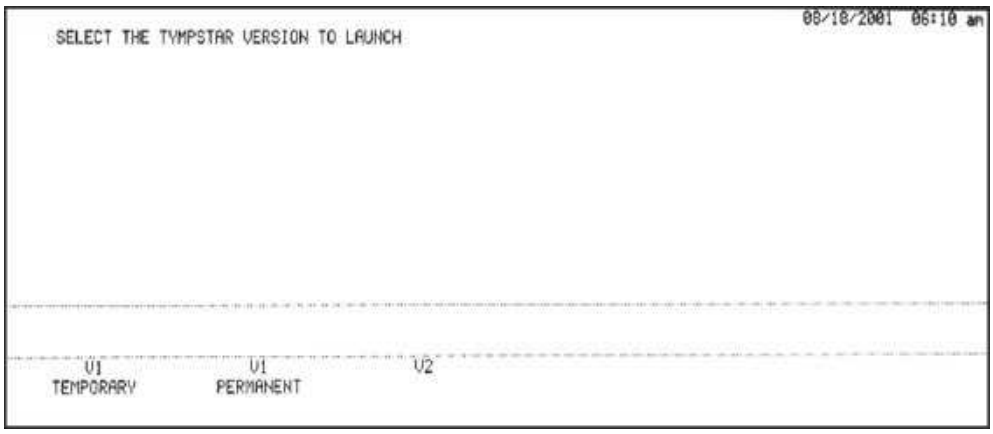
INTACT TM **PERF TM** **INSTRUMENT OPTIONS** **PROGRAM MODE**



2) Press the INSTRUMENT OPTIONS softkey, then the MORE softkey to display the VERSION softkey selection.



3) Press the VERSION softkey to display the Version Menu.



NOTE
To return to the Instrument Options menu with no version switching action taken, press the RETURN hardkey from the Version menu.

Switching to V1 temporarily

1) Press the V1 TEMPORARY softkey to change the instrument to V1 functionality temporarily. The message: SWITCHING TO A V1 INSTRUMENT. WAITING FOR WARM START will appear. The system will then reboot and reinitialize as a TympStar Version 1.

The V1 Temporary mode allows the instrument to be switched back to V2 mode. The instrument will stay in V1 Temporary mode indefinitely, until changed back to V2 mode as described below.

Switching back to V2

1) Press the V2 softkey in the Version Menu. Lock and key codes are displayed on the screen.

NOTE
Press the CONTINUE softkey from this screen to keep the TympStar in the V1 Temporary mode.

2) Press the DATA TRANSFER hardkey. The message: SWITCHING TO A V2 INSTRUMENT. WAITING FOR WARM START will appear. The system will then reboot and reinitialize as a TympStar Version 2.

Switching to V1 permanently

1) Press the V1 PERMANENT softkey in the Version Menu to change the instrument to V1 functionality permanently. The message: ARE YOU SURE YOU WANT TO CHANGE THIS TO A V1 INSTRUMENT? will appear.

CAUTION
Once an instrument is changed to V1 permanently it cannot be changed back to V2 without a license key from Grason-Stadler.

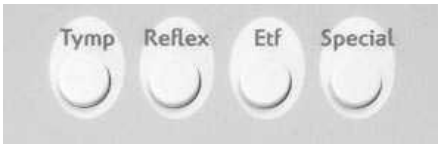
2) Press the YES softkey to switch the TympStar to a V1 instrument permanently. The message: SWITCHING TO A V1 INSTRUMENT. WAITING FOR WARM START will appear. The system will then reboot and reinitialize as a TympStar Version 1.

Changing from a Version 1 to a Version 2

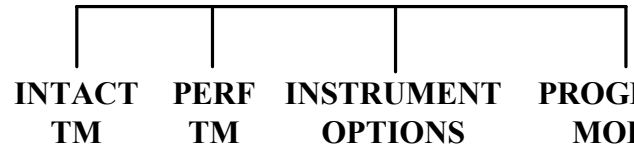
The Version function provides an easy way for a TympStar Version 1 to be upgraded to a Version 2 instrument. Version 2 functionality provides expanded testing capability and includes 678 and 1000 Hz probe tones, multi-frequency tympanometry and ARLT testing. A license code must be obtained from Grason-Stadler to upgrade a TympStar Version 1 to a Version 2.

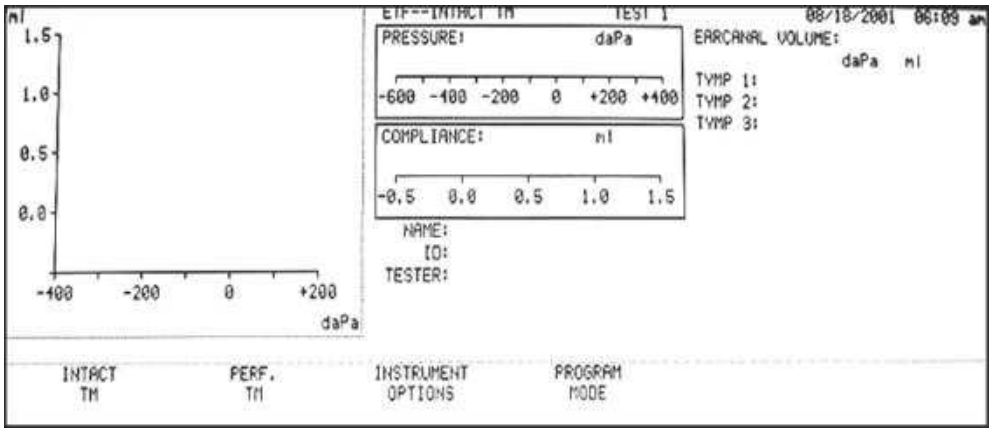
To change from a TympStar Version 1 to a Version 2:

1) Press the ETF hardkey to select the ETF test mode, then press the RETURN hardkey to display the ETF sub-menu.

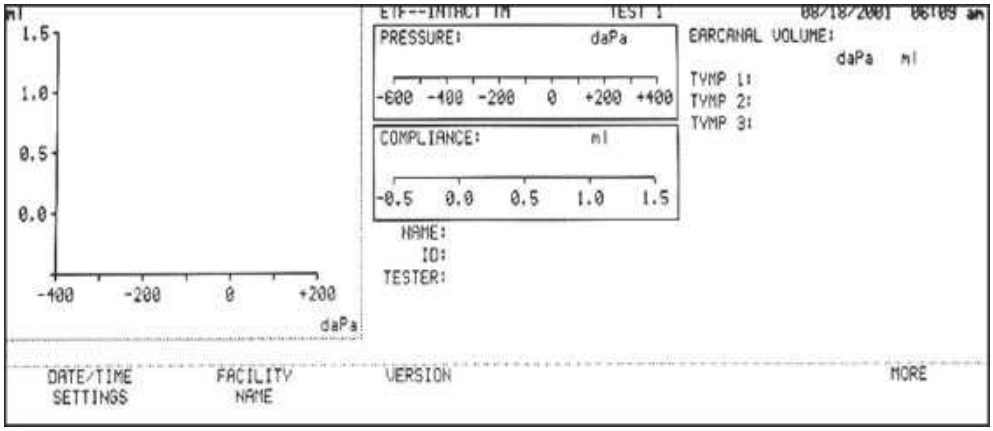


2) Press the INSTRUMENT OPTIONS

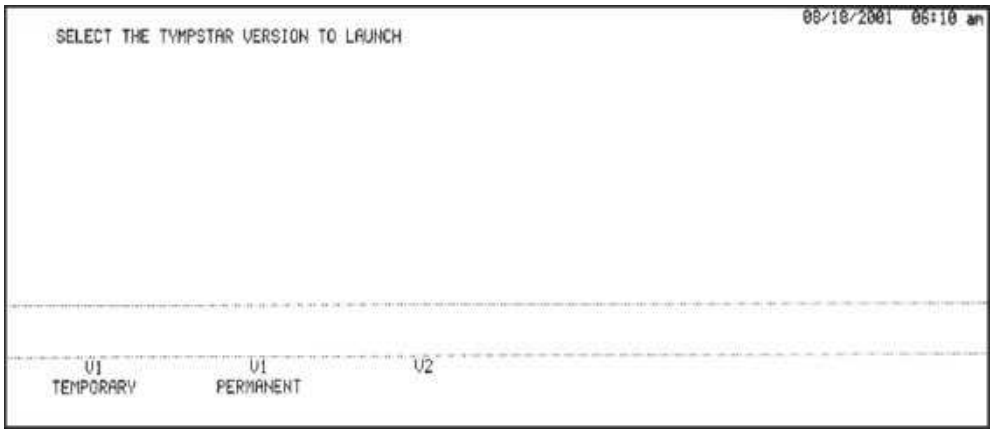




softkey, then the MORE softkey to display the VERSION softkey selection.



3) Press the VERSION softkey to display the Version Menu.



NOTE
To return to the Instrument Options menu with no version switching action taken, press the RETURN hardkey from the Version menu.

Obtaining a License Code

4) Press the V2 softkey. The following messages will appear:
YOU MUST OBTAIN A LICENSE KEY TO LAUNCH V2 TYMPSTAR
CONTACT YOUR GSI REPRESENTATIVE WITH THE FOLLOWING CODE:
0A2B3C4E5D *(example of lock code)*

YOUR GSI REPRESENTATIVE WILL PROVIDE YOU WITH A LICENSE KEY CODE.

ENTER THE LICENSE KEY CODE HERE:

THEN PRESS THE DATATRANSFER KEY

5) Press the PRINT hardkey to print out the lock code. Contact your GSI representative with the lock code. If a V2 upgrade is purchased, you will be provided with a license key code and V2 probe. Once you have received the V2

license key and probe, follow the instructions below to change the TympStar to V2 functionality.

NOTE
Press the CONTINUE softkey from this screen to keep the TympStar in V1 mode.

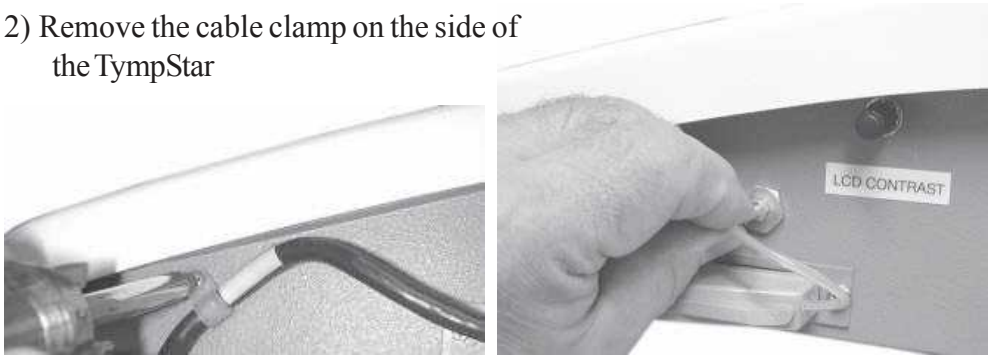
Replacing the V1 Probe with a V2 Probe

To replace the TympStar probe:

WARNING
Turn off power to the TympStar.

1) Disconnect the air tubing to the brass fitting on the side of the TympStar.

2) Remove the cable clamp on the side of the TympStar

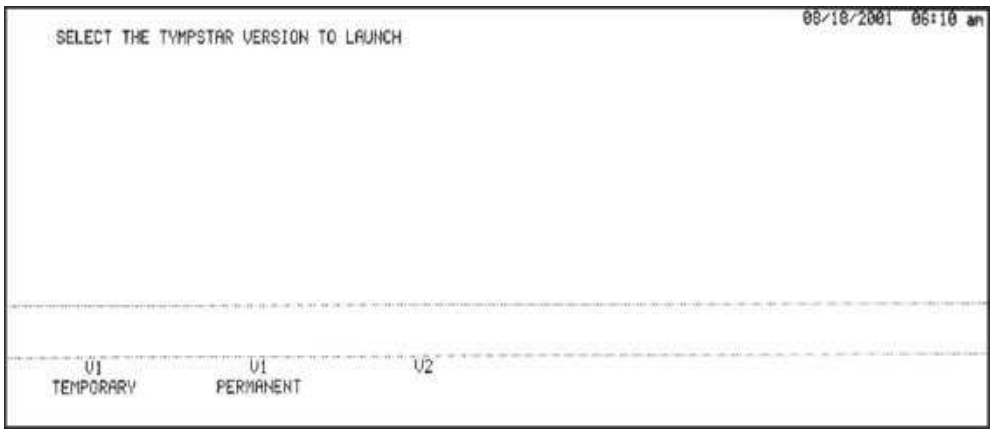


3) Remove the two retaining screws that secure the probe connector to the TympStar.

4) Pull the connector straight out and away from the side of the TympStar chassis.

Reverse this sequence to connect the new Version 2 probe to the TympStar. Contact your GSI representative to have the removed probe returned to GSI.

5) Connect an external keyboard, power the instrument and return to the VERSION sceen.



Switching to Version 2 software

1) Press the V2 softkey from the Version menu. The following messages will appear:

YOU MUST OBTAIN A LICENSE KEY TO LAUNCH V2 TYMPSTAR
CONTACTYOUR GSI REPRESENTATIVE WITHTHE FOLLOWING CODE:
0A2B3C4E5D *(example of lock code)*

YOUR GSI REPRESENTATIVE WILL PROVIDE YOU WITH A LICENSE KEY CODE.
ENTER THE LICENSE KEY CODE HERE:
THEN PRESS THE DATA TRANSFER KEY

Using an external keyboard, type in the license key code as indicated by the on-screen instructions. Press the DATA TRANSFER hardkey. The message: SWITCHING TO A V2 INSTRUMENT. WAITING FOR WARM START will appear. The system will then reboot and reinitialize as a V2 TympStar.

Version 1 test procedures

The following TympStar Version 1 test procedures are summarized. Comprehensive procedures are provided in the TympStar Version1User Manual.

Tymp diagnostic

1) Select test mode by turning POWER ON, or by pressing TYMP hardkey. Default test parameters are displayed above softkeys on the LCD.
2) Attach the probe box to the velcro strip on the shoulder probe mount.
3) Position the shoulder probe mount on the patient.
4) Position the appropriate size eartip on the probe tip and securely insert into the ear canal.
5) Press EAR softkey, then select LEFT or RIGHT ear.
6) Press ← START hardkey to initiate test.
7) View ongoing test results on the graphic display area and on the pressure and compliance meters.
8) Press the STOP hardkey to end the test, store the results in memory and display the summary data on the screen.

NOTE
A MANUALTYMP test may be initiated by pressing the MANUAL hardkey. Rotate the PRESSURE KNOB to vary pressure and view ongoing test results graphically, or on the pressure and compliance meters.

Manual Tymp

1) Securely place the probe tip within the patient's ear canal and press the TYMP hardkey.
2) Press the EAR softkey and select the right or left ear.
3) Press the MANUAL hardkey to pressurize the ear canal to the previously selected start pressure. Manual mode will appear below the Name, ID and Tester Information on the display.
4) Use the PRESSURE CONTROL knob to vary the pressure within the ear canal and control the speed of the tympanometric test.
5) View test results on the display along with the pressure and compliance meters. Test summary information is displayed to the right of the meters for the two most recent pressure sweeps.

NOTE
The ERASE hardkey can be used to delete test data prior to pressing the STOP hardkey.

6) Press the STOP hardkey to store the last two tracings in memory.
7) Press the PAGE hardkey to view test results.
8) Press the PRINT hardkey while in the PAGE mode for printed tests. MANUAL will appear on the printout indicating a manual test.

Tymp screening

1) Enter test mode by pressing TYMP followed by RETURN. Press the SCREEN softkey. Test will automatically start when a seal is detected.
2) Default test parameters are displayed above softkeys on the LCD.
3) Attach the probe box to the velcro strip on the shoulder probe mount or to the wristband probe mount.
4) Press the EAR softkey, then press LEFT or RIGHT ear.
5) Position the appropriate size SCREENING eartip on probe tip.
6) With the hand-held probe, obtain a seal at entrance to ear canal.

Probe lights indicate the following:

Solid Green	=	Test In Progress
Solid Amber	=	Occlusion
Blinking Amber	=	Leak
Blinking Green	=	OK To Begin A Test

7) Test will start automatically if ear canal seal is good. Screening IPSI Reflex test at 1 kHz will follow tymp.
8) A "Test Complete Remove Probe" message will appear on the display when the test is complete.
9) View test results on the graphic display area along with summary data at the right of the pressure and compliance meters.

Reflex threshold

1) Select test mode by pressing the REFLEX hardkey. Default test parameters are displayed above softkeys on the LCD.

NOTE
AUTO ZERO is used to baseline compliance.

2) Press the START hardkey to pressurize the ear to dynamic peak pressure maintained from the last Tymp, or to 0 daPa if no previous Tymp data is available. Pressure control is active for fine-tuning pressure if Tymp is sharply sloped.
3) Select intensity of stimulus by pressing the INTENSITY up and down arrow hardkeys.
4) Present auto-timed stimulus by momentarily pressing the PRESENT bar.
5) Press the ERASE hardkey to erase sub-threshold presentations or unwanted data (i.e. amplitudes of less than 0.02).
6) Press the CONTINUE softkey to allow reflex tracings to continue on next line of reflex screen and onto the next page in memory.
7) Use the STIMULUS up and down arrow hardkeys to select alternative test stimuli.

Automatic Auto Zero

Auto Zero is used to baseline admittance prior to or between stimulus presentations when performing acoustic Reflex Threshold, Reflex Decay, Acoustic Reflex Latency and Acoustic Reflex Sensitization tests.

Before pressing START, select the AUTO ZERO softkey followed by the AUTOMATIC softkey to activate this feature. The Admittance meter will automatically be zeroed each time the PRESENT bar is pressed.

The Admittance meter may be zeroed manually after pressing START by pressing the AUTO ZERO softkey as frequently as needed.

Mark Threshold

Often, multiple tracings are obtained per stimulus presentation, but only one represents the reflex threshold. Mark Threshold allows the operator to scroll across each line of data and select the intensity value determined to be the threshold.

1) Select the MARK THRESHOLD softkey.
2) Select the → softkey to move the cursor.
3) Press the MARK LINE 1 or MARK LINE 2 softkey to display the threshold marker (an asterisk).
4) Press the NR LINE 1 or NR LINE 2 softkey to display no response (NR).
5) Select EXIT softkey to return to the reflex threshold diagnostic menu.

Reflex Threshold Seeking

Threshold Seek automates the sequence of button presses used to arrive at reflex threshold values and also automates the marking of reflex threshold values.

NOTE
Threshold Seek should only be used with quiet, cooperative patients.

1) Select test mode by depressing REFLEX. Default test parameters are displayed above softkeys on the LCD.
2) Press the THRESHOLD SEEK softkey.
3) Press ON or CONFIGURE to change test parameters.
4) Press START to pressure ear to dynamic peak pressure maintained from last tymp, or to 0 daPa if no previous tymp data is available.
5) Present auto timed stimulus by momentarily depressing the PRESENT bar.
6) Press ERASE to erase unwanted data.
7) Select the CONTINUE softkey to allow reflex tracing to continue on the next line on the reflex screen.

NOTE
MANUAL REFLEX testing may be performed by pressing MANUAL and viewing responses to stimuli presentations on the compliance meter.

Reflex decay

1) Select test mode by pressing SPECIAL hardkey. Default test parameters are displayed above softkeys on the LCD.

NOTE
Alternative sensitivities for displayed reflex response may be selected by pressing ml SCALE softkey.

2) Dotted vertical lines are displayed above the X-axis of each graph marking 5 sec. and 10 sec. points.
3) Pressure is automatically maintained at the pressure of the last reflex threshold test. PRESSURE CONTROL is active for fine-tuning pressure.
4) Set the intensity of stimulus to 10 dB HL above the reflex threshold using the INTENSITY up and down arrow hardkeys.
5) Present stimulus by pressing the PRESENT bar momentarily.

NOTE
Summary data indicates the time at which 50% decay occurred, if appropriate.

6) Additional frequencies may be selected for testing using the STIMULUS up and down arrow hardkeys. (500 Hz and 1000 Hz are the best frequencies for this test.)
7) Press the STOP hardkey to end the reflex decay test and store current screen data in memory.

Eustachian tube function

Pressure Swallow Test (intact TM)

1) Select test mode by pressing ETF. Default test parameters for ETF-INTACT TM are displayed above softkeys on the LCD.
2) Press ← START to initiate automated test (TYMP 1).
3) View ongoing test results as shown on the graphic display area, or pressure compliance admittance meters.
4) Press HOLD when the desired pressure sweep limit is reached.
5) Follow the user directions displayed on status line of LCD prior to obtaining TYMP 2 results using the CONTINUE softkey.
6) Press HOLD when the desired pressure sweep limit for TYMP 2 is reached.
7) Follow the user directions displayed on status line of LCD prior to obtaining TYMP 3 results using the CONTINUE softkey.
8) Press STOP when the desired pressure sweep limit for TYMP 3 is reached.
9) If the Eustachian tube is functioning properly, view the shift in pressure peaks of TYMPS 2 and 3 relative to TYMP 1 on the graphic display area. Numeric summary data is displayed at the right of the compliance/ admittance meter.

Perforated Ear Test (Perforated TM)

1) Select ETF-Perforated TM by pressing ETF and RETURN followed by the PERF TM softkey.

2) Position the eartip within the ear canal.
3) Press START to initiate pressure sweep.
4) If the Eustachian tube opens during pressurization, the opening and closing pressures will be indicated in the summary data.
5) If the Eustachian tube doesn't open during pressurization, instruct the patient to swallow some water. The opening and closing pressures will be indicated.
6) Press STOP to end the test and store the results in memory.

Auto sequence testing

1) Press the TYMP hardkey to place the instrument in the tymp diagnostic mode.
2) Press the EAR softkey to select the test ear.
3) Select the AUTO SEQUENCE softkey to initiate the automatic Sequencing of tests.
4) The test sequence will automatically terminate upon completion of the last test with test results automatically stored in memory.
5) Test results can be viewed by pressing the PAGE hardkey and can then be printed by pressing the PRINT hardkey.

NOTE
The sequence of tests always includes Tymp 226 Hz, Y, and can be configured to include or exclude Reflex Threshold and Reflex Decay tests.

Programming auto sequence tests

1) Select the ETF hardkey followed by the RETURN hardkey.
2) Select the INSTRUMENT OPTIONS softkey and then press the TEST SEQUENCE softkey.
3) Select the REFLEX THRESHOLD softkey and press the ON/OFF softkey to activate or deactivate the reflex threshold.
4) Acoustic reflex measurements can be obtained ipsilaterally or contralaterally. Select the STIMULUS EAR softkey to select from the following Ipsi only, Contra only, or Ipsi and Contra for reflex testing.
5) Press the STIMULUS Hz softkey to select the stimulus to be included in the Reflex Threshold Auto Sequence. Scroll through each stimulus by pressing the up and down arrow softkeys and toggle the YES/NO softkey to program each stimulus for Reflex
Threshold testing in the auto test sequence.
6) Select the REFLEX DECAY softkey and press the ON/OFF softkey to activate or deactivate reflex decay.
7) Select the STIMULUS Hz softkey to select the stimuli for Reflex Decay testing. Press the up and down arrow softkeys to scroll through the stimuli and toggle the YES/NO softkey to select or de-select the stimulus.
8) Press the RETURN hardkey twice and press the STORE softkey to store test selections in memory.

Version 2 test procedures

The following TympStar Version 2 test procedures are summarized. Comprehensive procedures are provided in the TympStar Version 2 User Manual.

Tymp diagnostic

1) Select test mode by turning the POWER ON, or by pressing the TYMP hardkey.
2) Default test parameters are displayed above softkeys on the LCD.
   A) Selectable Probe Tone Hz- 226 Hz, 678 Hz, 1000 Hz
   B) Selectable Admittance Components- Y, B, G, B/G
3) Temporarily modify test parameters, by pressing the parameter softkey(s) to be changed. Use PROGRAM mode for more permanent changes.
   A) Alternative test parameters are displayed above the selected softkey.
   B) Press the desired test parameter softkey. The selected value is displayed on the parameter status line.
   C) Press BASELINE-OFF if the tymp test is performed with the following parameters:
      • Y with 678 Hz or 1000 Hz
      • B, G, or B/G with 226 Hz, 678 Hz, or 1000 Hz

NOTE
Pressing the B/G softkey allows B and G tracings to be run simultaneously.

4) Attach the probe box to the velcro strip on the shoulder probe mount.
5) Position the shoulder probe mount on the patient.
6) Position the appropriate size eartip on the probe tip and securely insert in the ear canal.
7) Press the EAR softkey, then press LEFT or RIGHT ear.
8) Press ← START to initiate test.
9) View ongoing test results on the graphic display area, and on pressure and admittance meters.
10) For tymp tests other than Y 226 Hz, the cursor is used to identify and set peak data points as follows:
    A) Press the CURSOR softkey.
    B) Use arrow softkeys to move the cursor to left or right on the graphic display. Observe numeric data in cursor box at the right of pressure meter.
    C) Press TYMP 1 SET PEAK softkey to specify and store peak data for TYMP 1. Follow the same procedure to specify and store selected peak data for TYMP 2 and 3.
    D) Press CURSOR-OFF.
11) Press STOP to end the test, store the results in memory, and display the summary data on the screen.

NOTE
A manual tymp test may be initiated by pressing the MANUAL hardkey. Rotate the pressure knob to vary pressure and view ongoing test results graphically, or on pressure and admittance meters.

Manual tymp

1) Securely insert the probe tip into the patient's ear canal and press the TYMP hardkey.
2) Press the EAR softkey to select the right or left ear.
3) Press the MANUAL hardkey to pressurize the ear canal to the previously selected start pressure. Manual mode will appear below the Name, ID and Tester Information on the display.
4) Use the PRESSURE CONTROL knob to vary the pressure within the ear canal and control the speed of the tympanometric test.
5) View test results on the display along with the pressure and compliance meters. Test summary information is displayed to the right of the meters for the two most recent pressure sweeps.

NOTE
The ERASE hardkey can be used to delete test data prior to pressing the STOP hardkey.

6) Press the STOP hardkey to store the last two tracings in memory.
7) Press the PAGE hardkey to view test results.
8) Press the PRINT hardkey while in the PAGE mode for printed tests. MANUAL will appear on the printout indicating a manual test.

Tymp screening

1) Enter test mode by pressing TYMP followed by RETURN. Press the SCREEN softkey.
2) Default test parameters are displayed above softkeys on the LCD. Only 226 Hz Y is available in this test mode.
3) Attach the probe box to the velcro strip on the shoulder probe mount or to the wristband probe mount.
4) Press the EAR softkey, then press LEFT or RIGHT ear.
5) Position the appropriate size SCREENING eartip on the probe tip.
6) With the hand-held probe, obtain a seal at the entrance to the ear canal.

Probe lights indicate the following:

Solid Green	=	Test In Progress
Solid Amber	=	Occlusion
Blinking Amber	=	Leak
Blinking Green	=	OK To Begin A Test

7) The test will start automatically when a seal is detected. Screening IPSI Reflex test at 1 kHz will follow tymp.

8) A"Test Complete Remove Probe" message will appear on the display when the test is complete.
9) View test results on the graphic display area along with summary data at the right of the pressure and compliance meters.

Reflex threshold

1) Select test mode by pressing REFLEX.
2) Default test parameters are displayed above softkeys on the LCD.
   A) Selectable Probe Tone Frequencies- 226 Hz, 678 Hz, 1000 Hz.
   B) Selectable Admittance Components- Y, B, G.
   C) AUTO ZERO is used to baseline admittance between stimulus presentations.

NOTE
Reflex responses may be inverted, or deflected in an upward direction when using higher probe tones. Direction of response may also differ when testing with Y, B or G components.

   D) Alternative sensitivities for displayed reflex response may be selected by pressing the ml SCALE softkey.
3) Press START to pressurize the ear to dynamic peak pressure maintained from last tymp, or to 0 daPa if no previous tymp data is available. Pressure control is active for fine-tuning pressure if tymp is sharply sloped, i.e., offset from peak by 10 to 15 daPa.
4) Select intensity of stimulus by pressing the INTENSITY up or down arrows. Press the STEP SIZE softkey to set 1, 2, or 5 dB steps.
5) Present auto-timed stimulus by momentarily pressing the PRESENT bar. (Stimulus may also be presented with manual timing.)
6) Press ERASE to erase sub-threshold presentations or unwanted data, i.e., amplitudes of less than 0.02 ml with 226 Hz, 0.06 mmhos with 678 Hz, or 0.09 mmhos with 1000 Hz.
7) Press the CONTINUE softkey to allow reflex tracings to continue onto the next line of reflex screen and onto the next page in memory.

NOTE
When CONTINUE is selected, test results are stored in memory and may not be erased.

8) The STIMULUS up and down arrow hardkeys are used to select alternative test stimuli.
9) The CURSOR softkey may be used to examine data points from individual tracings.
10) If Reflex Decay, ARLT, or AR Sensitization testing is to be done on the same ear, press the SPECIAL hardkey without pressing STOP. This allows the pressure from Reflex Threshold to be maintained for the next test. If not, press STOP to terminate testing.

Automatic auto zero

Auto Zero is used to baseline admittance prior to or between stimulus presentations when performing acoustic Reflex Threshold, Reflex Decay, Acoustic Reflex Latency and Acoustic Reflex Sensitization tests.
Before pressing START, select the AUTO ZERO softkey followed by the AUTOMATIC softkey to activate this feature. The Admittance meter will automatically be zeroed each time the PRESENT bar is pressed.

The Admittance meter may be zeroed manually after pressing START by pressing the AUTO ZERO softkey as frequently as needed.

Mark Threshold

Often multiple tracings are obtained per stimulus presentation, but only one represents the reflex threshold. Mark Threshold allows the operator to scroll across each line of data and select the intensity value determined to be the threshold.

1) Select the MARK THRESHOLD softkey.
2) Select the → softkey to move the cursor.
3) Press the MARK LINE 1 or MARK LINE 2 softkey to display the threshold marker (an asterisk).
4) Press the NR LINE 1 or NR LINE 2 softkey to display no response (NR).
5) Select the EXIT softkey to return to the reflex threshold diagnostic menu.

Reflex Threshold Seeking
threshold

Threshold Seek automates the sequence of stimulus presentations used to determine the reflex threshold values and also automates the marking of reflex values.

NOTE
Threshold Seek should only be used with quiet, cooperative patients.

1) Select test mode by depressing REFLEX. Default test parameters are displayed above softkeys on the LCD.
2) Press the THRESHOLD SEEK softkey.
3) Press ON or CONFIGURE to change test parameters.
4) Press START to pressure the ear to the dynamic peak pressure maintained from the last tymp, or to 0 daPa if no previous tymp data is available.
5) Present auto timed stimulus by momentarily depressing the PRESENT bar.
6) Press ERASE to erase unwanted data.
7) Select the CONTINUE softkey to allow reflex tracing to continue on the next line on the reflex screen.

NOTE
MANUAL REFLEX testing may be performed by pressing MANUAL and viewing responses to stimuli presentations on the compliance meter.

Reflex decay

1) Select test mode by pressing SPECIAL.
2) Default test parameters are displayed above softkeys on the LCD.
   A) Selectable Probe Tone Frequencies- 226 Hz, 678 Hz.
   B) Selectable Admittance Components- Y, B, G.
   C) Alternative sensitivities for displayed reflex response may be selected by pressing the ml SCALE softkey.
   D) Maximum selectable stimulus ON TIME is limited by selected TIMEBASE.
   E) AUTO ZERO is used to baseline admittance between stimulus presentations.
3) Dotted vertical lines indicate 5 second and 10 second points.
4) Pressure control is active for fine-tuning pressure.
5) Set intensity of stimulus to 10 dB above reflex threshold by pressing the INTENSITY up or down arrows. Step size may be set to 1, 2, or 5 dB using STEP SIZE softkey.
6) Present stimulus by pressing the PRESENT bar momentarily. First press START if pressure was not maintained from a prior reflex test.

NOTE
Summary data indicates the time at which 50% decay occurred, if appropriate. CURSOR softkeys may be used to define numeric points on Line 1 and Line 2 of the graphics area.

7) Additional frequencies may be tested by using the STIMULUS up and down arrow hardkeys. (500 Hz and 1000 Hz are the most suited frequencies for this test.)
8) Go directly to another reflex test without pressing STOP to maintain pressure within the ear canal, or press STOP to terminate reflex decay testing.

Acoustic reflex latency test (ARLT)

1) Press SPECIAL followed by RETURN.
2) Select test mode by pressing the ARLT softkey. Default test parameters are displayed above softkeys on the LCD.
   A) ARLT is performed with a 226 Hz Probe Tone. Y, B or G may be selected.
   B) Maximum selectable ON-TIME of the stimulus is limited by selected TIMEBASE.
   C) Alternative sensitivities for displayed reflex response may be selected by pressing the ml SCALE softkey.
   D) Press the AVERAGE softkey to change number of reflex responses to be averaged.
3) The pressure knob is active for fine-tuning pressure.
4) Set the intensity of stimulus to 10 dB above the reflex threshold by pressing INTENSITY up and down arrows. Step size may be set to 1, 2, or 5 dB using the STEP SIZE softkey.

5) Use AUTO ZERO, if necessary, to zero admittance prior to presenting stimulus.
6) Present stimulus by pressing the PRESENT bar momentarily. First press START if pressure was not maintained from a prior reflex test.
7) The following points are identified by short vertical lines on the ARLT display:
   A) Time from signal onset to points where reflex curve reaches 10% and 90% of its maximum amplitude.
   B) Time from signal offset to points where reflex curve decays to 90% and 10% of its maximum amplitude.

NOTE
Numeric summary data indicates the 10% and 90% ON and OFF points of the response for Line 1 and Line 2. CURSOR softkeys may be used to define numeric points on X and Y axes of Line 1 and 2.

8) Additional frequencies may be tested by using STIMULUS up and down arrow hardkeys.
9) Go directly to another reflex test without pressing STOP to maintain pressure within the ear canal, or press STOP to terminate ARLT testing.

Acoustic reflex sensitization (A.R. SENSI)

1) Press SPECIAL followed by RETURN.
2) Select test mode by pressing the A.R. SENSI softkey. Default test parameters are displayed above the softkeys on the LCD. The test is performed with a 226 Hz probe tone. Y, B, or G may be selected.

NOTE
The facilitator (sensitizing signal) threshold level should be known prior to selecting the facilitator parameters (6 kHz or BBN are most suited for facilitator stimuli).

3) Press the STIMULUS EAR softkey and press IPSI or CONTRA to obtain reflex threshold data if threshold information per stimulus has not already been obtained. Use the same procedure as in Reflex Threshold.
   A) IPSI stimuli available- 0.5, 1, 2, 4, 6 kHz, EXT, and N-A.
   B) CONTRA stimuli available- 0.25, 0.5, l, 2, 4, 6 kHz, BBN, EXT, and N-A.

NOTE
STEP SIZE should be set to 1 or 2 dB to obtain precise threshold data.

4) The facilitating (f) and activating (a) stimuli may be presented IPSI (I) or CONTRA (C). Use the STIMULUS EAR softkey to press the desired Combination- CfIa, CfCa, IfCa, Ifia.
5) To select the facilitator stimulus and intensity, press the FACILITATOR softkey.

A) Use the STIMULUS up and down arrows to select the desired high frequency stimulus.
B) Use the INTENSITY up and down arrows to set the intensity level. Try 3 to 4 dB below threshold level for selected stimulus.
C) Press EXIT.

6) The activator stimulus and intensity may now be selected.
A) Use the STIMULUS up and down arrows to select the desired stimulus.
B) Press the STEP SIZE softkey to select 1, 2, or 5 dB steps.
C) Use the INTENSITY up and down arrows to set dB level. Start the intensity of the activator at a very low level, e.g., 40 dB to determine threshold value.
• IPSI Stimuli available- 0.5, 1, 2, 4 kHz, EXT, and N-A.
• CONTRA Stimuli available- 0.25, 0.5, l, 2, 4 kHz, BBN, EXT, and N-A.
7) Press PRESENT to simultaneously present facilitating and activating stimuli. First press START if pressure was not maintained from a prior reflex test.
8) Press ERASE to delete sub-threshold presentations or unwanted data, i.e.: amplitudes below 0.02 ml.
9) Press STOP to terminate testing.

Eustachian tube function

Pressure Swallow Test (intact TM)

1) Select test mode by pressing ETF. Default test parameters for ETF-INTACT TM are displayed above the softkeys on the LCD.
2) Press ← START to initiate automated test (TYMP 1).
3) View ongoing test results as shown on graphic display area, or pressure compliance admittance meters.
4) Press HOLD when desired pressure sweep limit is reached.
5) Follow the user directions displayed on the status line of the LCD prior to obtaining the TYMP 2 results using the CONTINUE softkey.
6) Press HOLD when the desired pressure sweep limit for TYMP 2 is reached.
7) Follow user directions displayed on status line of LCD prior to obtaining TYMP 3 results using CONTINUE softkey.
8) Press STOP when desired pressure sweep limit for TYMP 3 is reached.
9) If the Eustachian tube is functioning properly, view the shift in pressure peaks of TYMPS 2 and 3 relative to TYMP 1 on the graphic display area. Numeric summary data is displayed at the right of the compliance/admittance meter.

Perforated Ear Test (Perforated TM)

1) Select ETF-Perforated TM by pressing ETF (if not already pressed) and RETURN followed by PERF TM softkey.
2) Position eartip within ear canal.
3) Press START to initiate the pressure sweep.

4) If the Eustachian tube opens during pressurization, the opening and clos ing pressures will be indicated in the summary data.
5) If the Eustachian tube doesn't open during pressurization, instruct the patient to swallow some water. The opening and closing pressures will be indicated.
6) Press STOP to end the test and store the results in memory.

Multiple frequency tympanometry (MULTIPLE Hz)

1) Press CLEAR. Press the CLEAR ALL softkey to ensure the availability of 26 pages of memory.
2) Press SPECIAL followed by RETURN.
3) Select test mode by pressing the MULITIPLE Hz softkey. Default test parameters for TEST 1 of the test series are displayed above softkeys on the LCD.
   A) The GSI TympStar automatically runs a 226 Hz Y tymp to determine the peak pressure value for the second probe frequency sweep.
   B) The ADMITTANCE softkey indicates which component is measured as a function of probe frequency at the start and peak pressures (B is the best component for this test).

NOTE
It may be helpful to select a sweep rate of 12.5 daPa/sec for sharply sloped tymps.

4) Ensure that the ear canal is securely sealed.
5) Press ← START to initiate test. Probe tone automatically sweeps from 250 Hz to 2000 Hz in 50 Hz steps at start pressure.
6) Next, Y 226 Hz tymp data is collected and displayed as TEST 1 of the series. As in Tymp Diagnostic Mode, press HOLD at desired stopping pressure or allow pressure sweep to continue to -400 daPa.
   A) Tymp summary data will be displayed at the right of the admittance meter.
   B) Use CURSOR if a different peak pressure value is desired.
7) Press the CONTINUE softkey to initiate TEST 2 of the series. Probe tone automatically sweeps from 250 Hz to 2000 Hz in 50 Hz steps at tymp peak pressure.
8) DB (or DY, or DG, if selected) are calculated and plotted as a function of probe frequency on upper graph display. Changes in phase of admittance (Dq) as a function of probe frequency are calculated and plotted on the lower graph.

NOTE
DY, B, or G values and Dq values are calculated as the difference between values obtained at peak pressure versus start pressure.

9) A cursor line approximates the resonance point of the ear along the Hz axis.
   A) CURSOR left and right arrow softkeys may be used to specify a different Hz point for DY, B, or G values and Dq . Press SET Hz softkey to record the new value.
   B) Cursor position now determines probe frequency for next tymp.
10) Press CONTINUE to display tymp format for TEST 3 of the series.
11) Press START or CONTINUE to obtain a tymp at this probe frequency.
   A) Tymp data is displayed on screen for selected probe frequency.
   B) Use CURSOR left and right arrow softkeys to specify and set peak admittance and pressure.
12) Test sequence can be terminated by selecting STOP,
   OR
13) Tymps can be obtained for frequencies below and above identified resonance point of the ear. To select probe tone frequency for next tymp:
   A) Press the PROBE Hz softkey. Use up and down arrows to display desired Hz. Press SET Hz softkey to select probe tone. Use ← START or CONTINUE to run next tymp.
   OR
   B) Press DELTA DISPLAY softkey to return to delta display screen. Cursor line indicates probe frequency from last tymp. Press CURSOR to select new probe tone frequency. Press CONTINUE followed by ← START or CONTINUE to begin next tymp.
14) Press STOP to end the test.

Auto sequence testing

1) Press the TYMP hardkey to place the instrument in the tymp diagnostic mode.
2) Press the EAR softkey to select the test ear.
3) Select the AUTO SEQUENCE softkey to initiate the automatic sequencing of tests.
4) The test sequence will automatically terminate upon completion of the last test with test results automatically stored in memory.
5) Test results can be viewed by pressing the PAGE hardkey and can then be printed by pressing the PRINT hardkey.

NOTE
The sequence of tests always includes Tymp 226 Hz, Y, and can be configured to include or exclude Reflex Threshold and Reflex Decay tests.

Programming auto sequence tests

1) Select the ETF hardkey followed by the RETURN hardkey.
2) Select the INSTRUMENT OPTIONS softkey and then press the TEST SEQUENCE softkey.
3) Select the REFLEX THRESHOLD softkey and press the ON/OFF softkey to activate or deactivate reflex threshold.
4) Acoustic reflex measurements can be obtained ipsilaterally or contralaterally. Select the STIMULUS EAR softkey to choose from Ipsi only, Contra only, or Ipsi and Contra for reflex testing.
5) Press the STIMULUS Hz softkey to select the stimulus to be included in the Reflex Threshold Auto Sequence. Scroll through each stimulus by pressing the up and down arrow softkeys to scroll through the stimuli and toggle the YES/NO softkey to program each stimulus for Reflex Threshold testing in the auto test sequence.
6) Select the REFLEX DECAY softkey and press the ON/OFF softkey to activate or deactivate reflex decay.
7) Select the STIMULUS Hz softkey to select the stimuli for Reflex Decay testing. Press the up and down arrow softkeys to scroll through the stimuli and toggle the YES/NO softkey to select or de-select the stimulus.
8) Press the RETURN hardkey twice and press the STORE softkey to store test selections in memory.

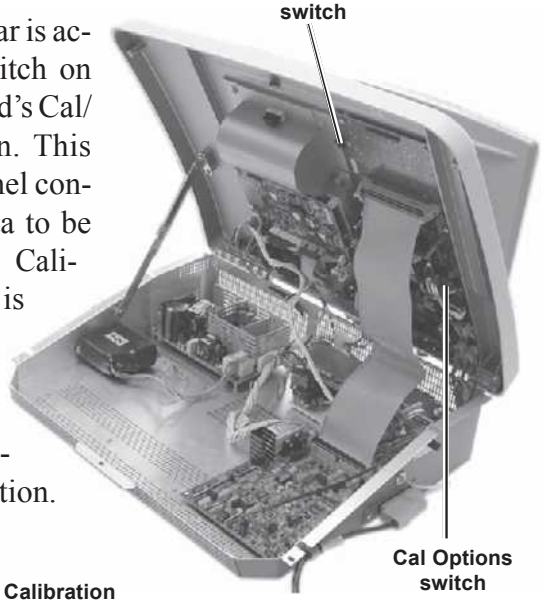
Calibration 4

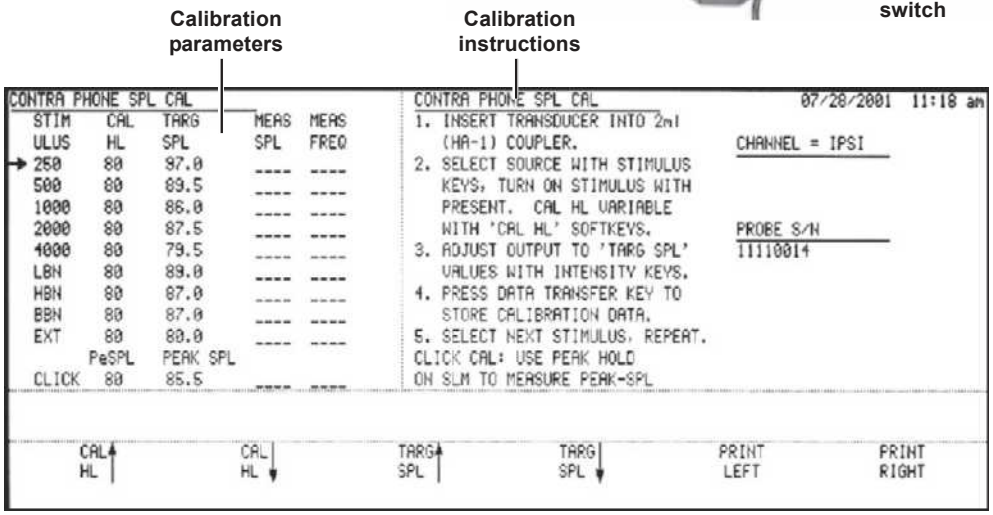
Introduction

This chapter describes how to calibrate the TympStar Middle-Ear Analyzer. These instructions are intended for persons experienced in the use of sound level meters, calibration sound sources, acoustic test cavities and the requirements of test calibration documentation.

Calibration measurement data will be recorded by the TympStar and can be printed during the calibration process.

The calibration mode of the TympStar is activated by configuring the DIP switch on the digital board and turning the board's Cal/Normal switch to the ON position. This changes the function of the front panel controls, permitting the calibration data to be stored in the TympStar's memory. Calibration is an interactive process and is assisted greatly by instruction provided on the TympStar's LCD display. The display will show current measurement parameters and give instructions for completing the calibration.





This chapter includes:

When to calibrate the TympStar

The TympStar must be calibrated when the digital, PC104 or analog board is repaired, if a transducer is changed or if the probe is repaired. Probe tone frequency data (Self-Cal data) are stored in the TympStar instrument. All other data for transducers and pressure are stored in the probe. Normally, circuit boards or the probe can be replaced with new complements from the factory without the need for calibration.

GSI recommends quarterly calibration checks for the GSI TympStar along with annual certification. ASHA requires quarterly electro-acoustic calibration checks and annual electro-acoustic calibration. It is good practice to perform daily biologic checks.

Calibration requirements

Some aspects of TympStar calibration can be checked singularly without the need for a complete or routine calibration sequence by simply navigating through the calibration menus to the desired screen and performing the check. However, calibration is typically as a complete calibration sequence or as a routine calibration sequence.

Complete calibration sequence

A complete calibration sequence must be performed if the following occurs:

- A performance problem is suspected
- A repair has been made to the TympStar involving the digital board, analog board, PC104 board, probe box or transducers

The complete calibration sequence must include the following:

- Loading default data and performing Self-Cal
- Contra, Ipsi and probe tone SPL calibrations
- Y (Version 1) or Y/B/G (Version 2) calibration
- Pressure system calibration

Upon completion of a complete calibration sequence, return to the normal mode and check compliance calibration at 0 daPa. Then enter Reflex Decay test (under the SPECIAL hardkey) and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

A routine calibration sequence should be performed quarterly or annually and includes:

- Check the Contra, Ipsi and probe tone SPL calibration and recalibrate if necessary
- Perform Y or Y/B/G calibration
- Check the pressure system calibration and recalibrate if necessary

Routine calibration sequence

Upon completion of a routine calibration sequence, return to the normal mode and check compliance calibration at 0 daPa. Then enter Reflex Decay test (under the SPECIAL hardkey) and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

Preparing for calibration

WARNING
It will be necessary to perform tasks within the TympStar enclosure while power is applied to the instrument. Do not touch electrical circuitry, wiring or complements. Voltages are present inside the enclosure that can cause severe personal injury or death!

CAUTION
Verify that the probe tip is clean and the probe tubes are clean and undamaged before attempting calibration.

Tools and equipment required

The tools and equipment required for calibration includes:

- Type 1 sound level meter
- 2 cc HA-1 coupler
- Electronic manometer
- Philips screwdriver
- Small straight edge screwdriver

Cleaning the probe and Contra phone

To ensure calibration accuracy, it is essential to clean the probe tip and Contra phone prior to calibration.

Probe

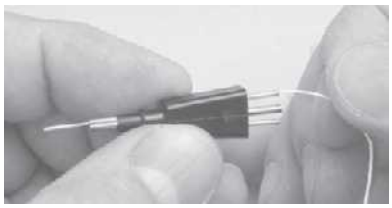
Step 1
Remove the probe eartip and tygon tubing attached to the three metal probe tubes at the rear of the probe tip.

CAUTION
Do not alter the length of the tubing by cutting it. When reconnecting the tygon tubing to the probe tubes, ensure that there are no sharp edges or burrs on the probe tubes that could cut the tygon tubing.

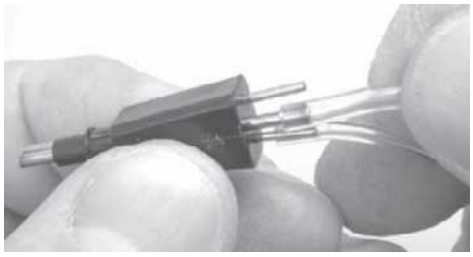
Step 2
Using the cleaning floss shipped with your instrument, remove debris from each tube by pushing the floss through the tube from the back to the front of the probe tip.

CAUTION
Avoid getting the probe moist. Place a new single-use eartip on the probe for each patient.

Feed the stiff end of the cleaning floss into the tube and pull the floss completely through the tube. Discard the used floss. Repeat this process for each of the remaining probe tubes. Do not reuse floss.

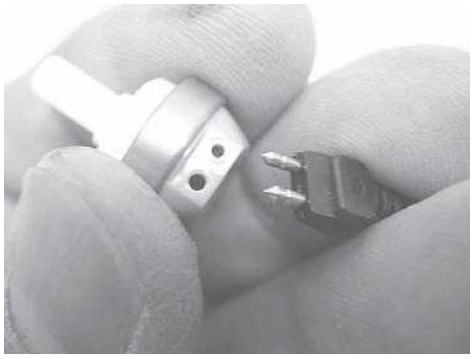


Step 3
Reconnect the tygon tubing to the probe tubes. The center tube has the larger diameter.



Contra phone

Step 1
Unplug the Contra phone from the jack on the probe box and make sure the main transducer opening is clear.

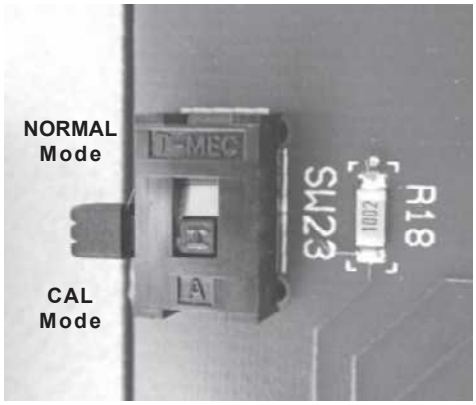


Step 2
Unplug the Contra phone cable from the transducer by pulling the cable connector straight away from the transducer body.

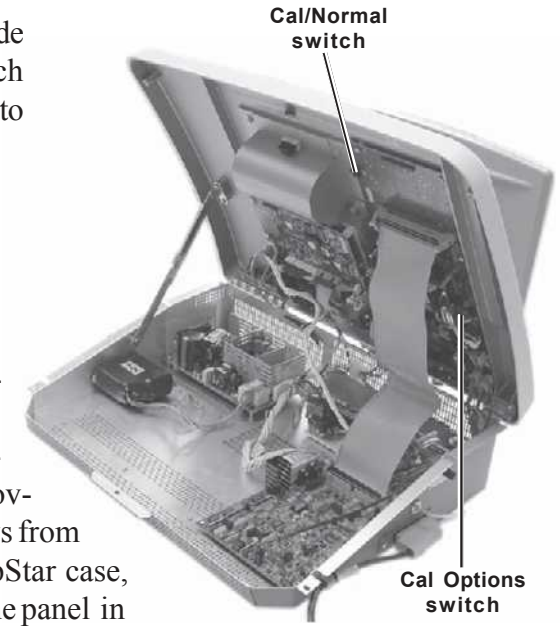
Step 3
Use isopropyl alcohol and a clean tissue or Q-tip to clean the two jacks in the Contra phone body, and the two Contra phone cable plugs.

Cal/Normal switch

The Cal/Normal switch is located on the digital board and is used to gain access to the calibration mode. Access to the switch is gained by removing the three Philips retaining screws from the bottom front edge of the TympStar case, lifting the front panel and locking the panel in the open position.



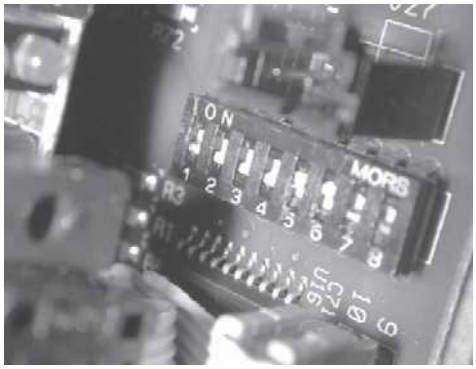
The Cal/Normal switch is located on the top left of the digital board is used to switch between the normal test mode and the calibration mode. The switch must be placed in the down position to perform calibrations and diagnostics.



Cal Option DIP switch

The Cal Option DIP switch is located on the digital board is used to configure calibration options. Access to the switch is gained by removing the three Philips retaining screws from the bottom front edge of the TympStar case, lifting the front panel and locking the panel in the open position.

The Cal Option switch is an eight position DIP switch located on the right-center portion of the digital board. Individual switches are ON in the up position or OFF in the down position. The individual switches are numbered on the switch.



Cal Option switch position functions are listed below:
Switch 1: Factory use only
Switch 2: GSI/custom RTL transducer calibration
Switch 3: Unused
Switch 4: Unused
Switch 5: Unused
Switch 6: Diagnostic mode
Switch 7: Self-Cal
Switch 8: Load default calibration data

The Cal Option switch settings are read by the system when the following occurs:

- The system power is on and the Cal/Normal switch is moved to the Cal position
- The Cal/Normal switch is in the Cal position and the system power is turned on

Switch 1: Factory use only

Factory use only

Switch 2: GSI/custom RTL transducer calibration

This position is used to activate the TARG SPL softkeys in the Ipsi and Contra calibration modes. The TARG SPL softkeys allow the reference threshold values (RTL) and output levels to be offset from the default GSI values by a maximum of plus or minus 10 dB. If the TARG SPL softkeys are pressed and released, the output level and LCD indicated value will change by 0.5 dB. If these softkeys are pressed and held, the output level and LCD indicated value would scroll in the direction indicated by the TARG SPL arrow. The custom calibration levels will be stored by the system when the Data Transfer button is pressed.

NOTE
If the TympStar is set to the custom mode, all references to dB HL on the LCD and printer during normal operation will be followed by the words "NON-GSI". This is so that all test results will clearly indicate that the stimulus SPL's were not at GSI standard levels. Also, the program that adjusts stimulus SPL based on total load volume is bypassed. The program subtracts 1.0 dB per 0.1 ml for loads of 1.1 ml down to 0.15 ml (-1.0db/0.1 ml).

Switch 3: Unused

Unused

Switch 4: Unused

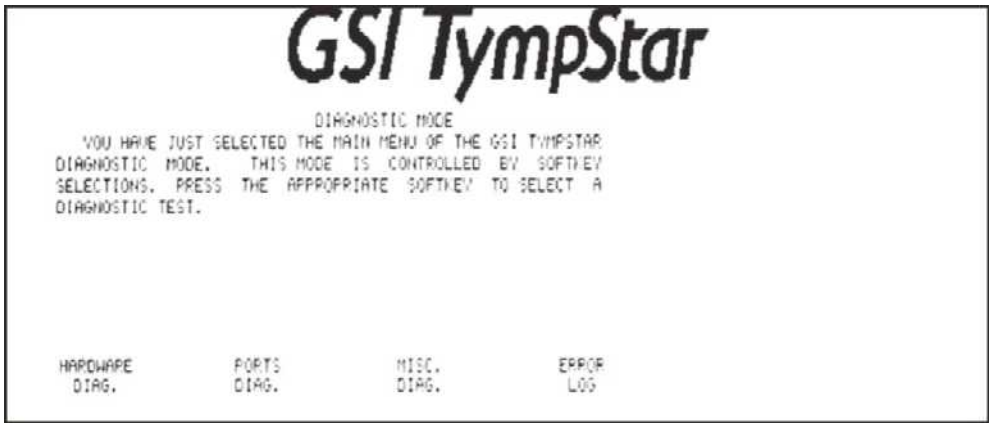
Unused

Switch 5: Unused

Unused

Switch 6: Diagnostic mode

This position will activate the diagnostic portion of the Cal mode when the Cal/Normal switch is in the Cal position. The Diagnostic Mode Screen will be displayed.

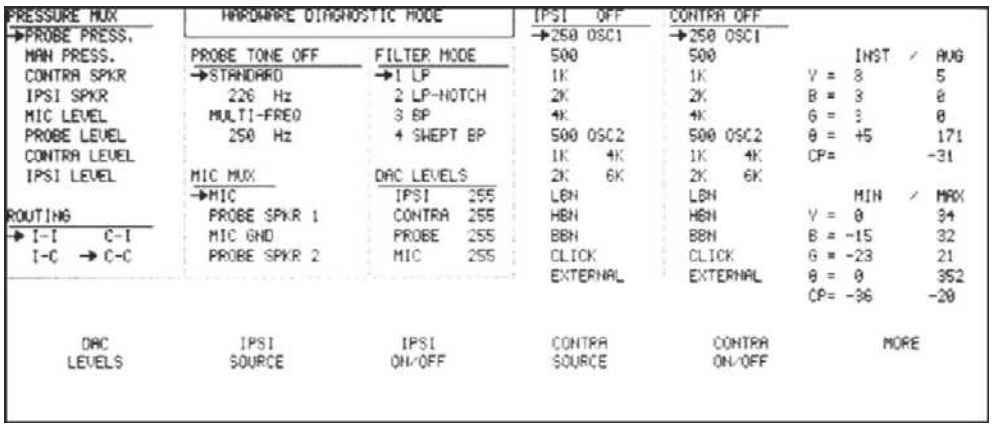


Four diagnostic functions are displayed above softkeys at the bottom of the screen. These include the following:

- Hardware Diagnostics
- Ports Diagnostics
- Miscellaneous Diagnostics
- Error Log

Hardware Diagnostics

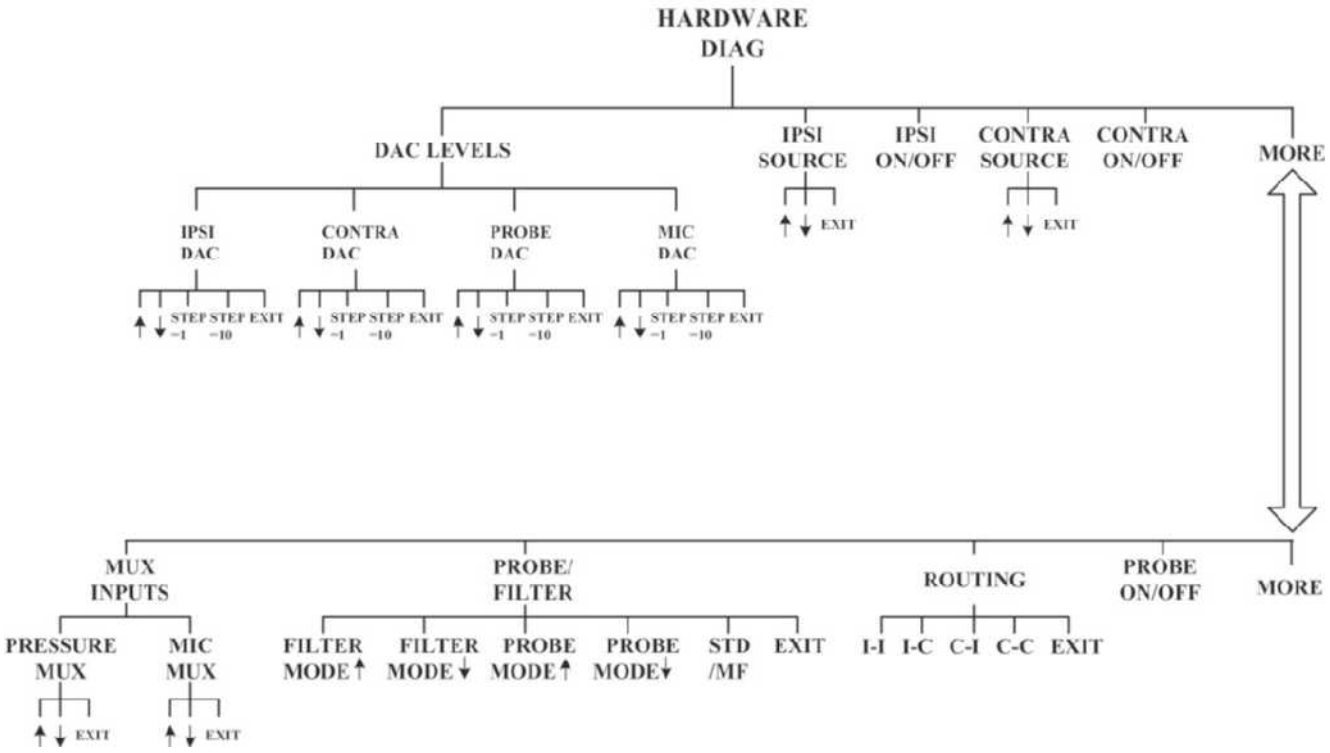
Pressing the HARDWARE DIAG softkey displays the Hardware Diagnostic Mode screen.



The right side of the screen shows real-time analog to digital (A/D) values for the Y, B, G and q MIC circuit outputs. Minimum and maximum values are also shown.

The CP value displays the control processor A/D output for the selected source to the pressure MUX.

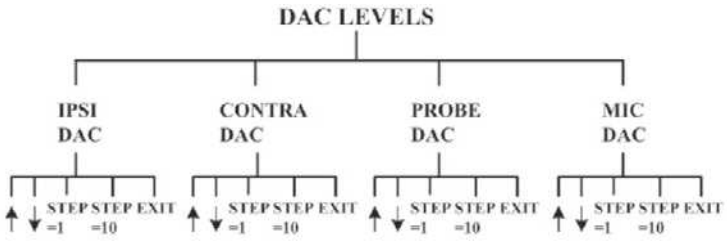
The Hardware Diagnostic Mode Menu structure is shown below.

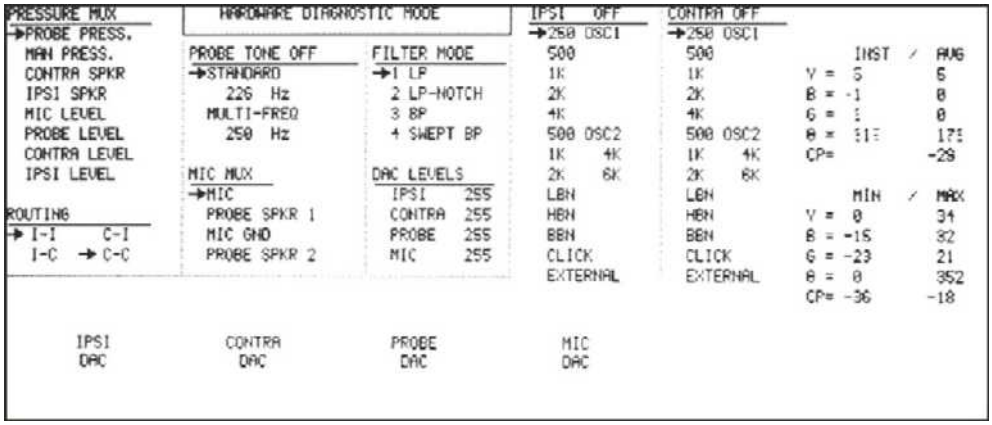


DAC LEVELS

Digital to analog (DAC) converters are used to adjust the gain of voltage controlled amplifiers for the IPSI, CONTRA, PROBE and MIC circuits. The DAC levels and associated circuit gain can be manually adjusted using the DAC LEVEL function.

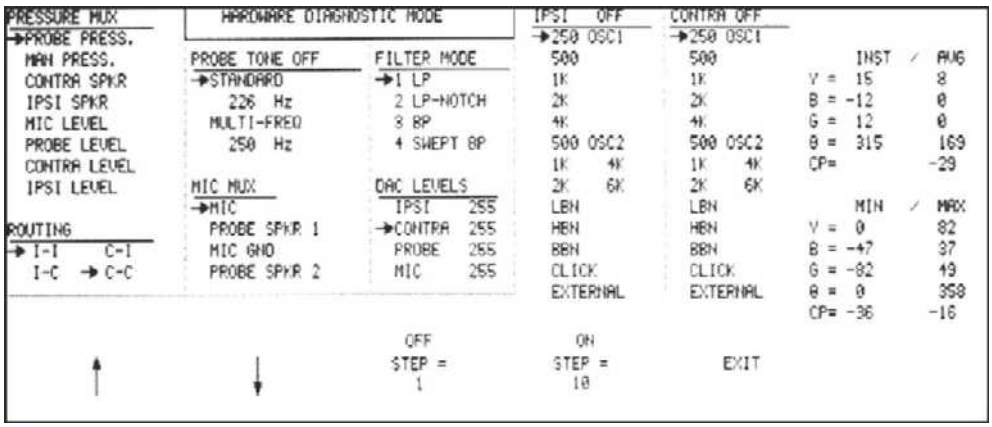
Pressing the DAC LEVEL softkey displays the DAC level menu above softkeys at the bottom of the LCD.





The gain for the desired circuit can be adjusted by pressing the corresponding softkey.

The selected circuit will be indicated in the left column of the DAC LEVELS portion of the LCD screen with its level shown in the right column. The example below shows the contra circuit selected with a level of 255.



NOTE

NOTE
The IPSI/CONTRA/PROBE outputs must be turned ON using the IPSI ON/OFF, CONTRA ON/OFF or PROBE ON/OFF softkey.

The minimum gain for each circuit corresponds to a DAC value of 0, the maximum corresponds to 255.

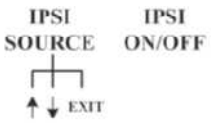
The DAC Level is adjusted by pressing the UP and DOWN ARROW softkeys. The adjustment increment can be set to step values of 1 or 10 by pressing the STEP=1 or STEP=10 softkey.

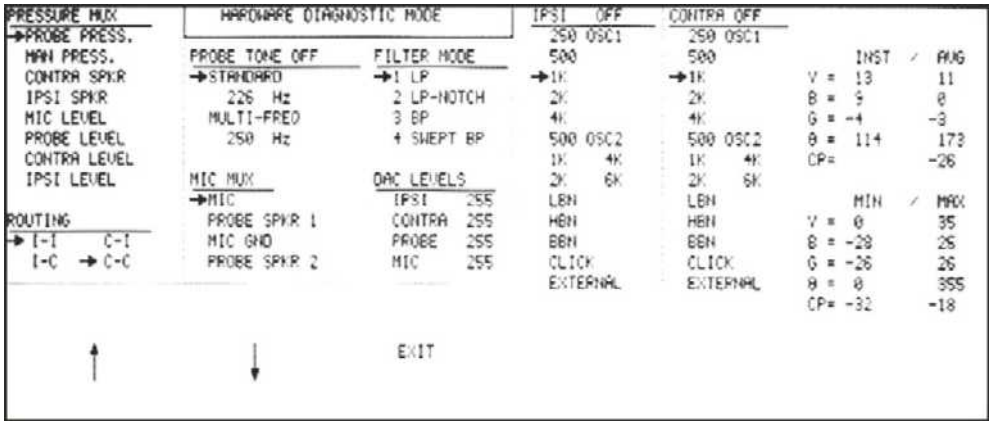
Pressing EXIT returns the display to the DAC level menu, where other circuits can be selected and adjusted in the same manner.

Pressing the RETURN hardkey displays the Hardware Diagnostic Mode menu at the bottom of the screen.

IPSI SOURCE

The signal source for the IPSI channel can be selected by pressing the IPSI SOURCE softkey. The possible IPSI sources are shown in the center of the LCD in the IPSI list.



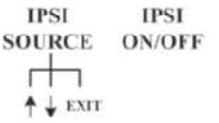


The desired source can be selected by scrolling through the list using the UP and DOWN NO CAPS softkeys. This example shows the 1K Hz source selected.

Pressing the EXIT softkey displays the Hardware Diagnostic Mode menu at the bottom of the screen.

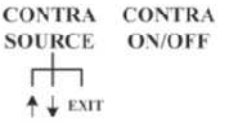
IPSI ON/OFF

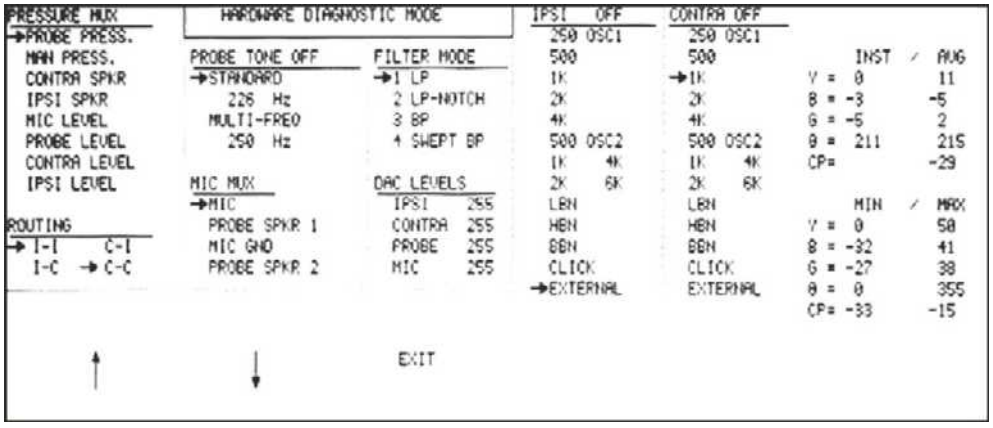
The IPSI output channel is toggled ON or OFF by pressing the IPSI ON/OFF softkey.



CONTRA SOURCE

The signal source for the CONTRA channel can be selected by pressing the CONTRA SOURCE softkey. The possible CONTRA sources are shown in the center of the LCD in the CONTRA list.

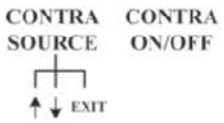




The desired source can be selected by scrolling through the list using the UP and DOWN No CAPS softkeys. This example shows the 1K Hz source selected.

CONTRA ON/OFF

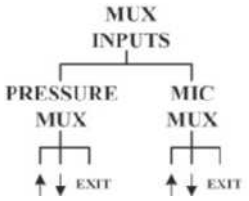
Pressing the EXIT softkey displays the Hardware Diagnostic Mode menu at the bottom of the screen.

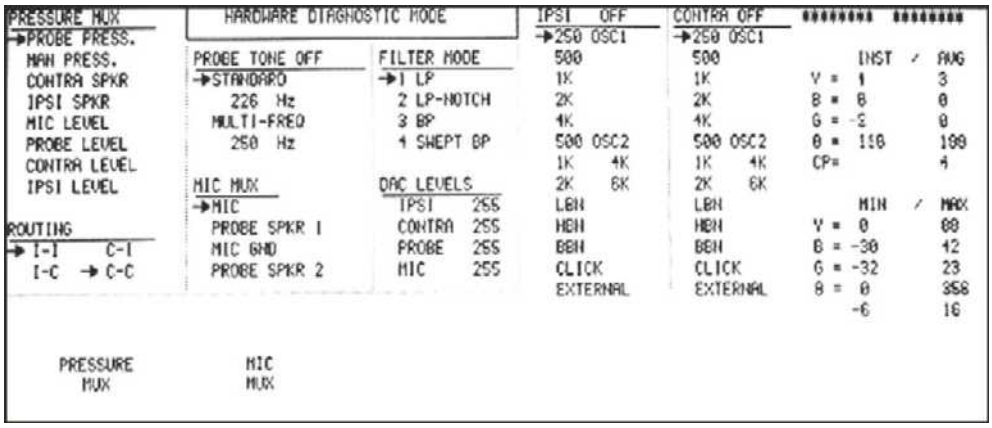


The CONTRA output channel is toggled ON or OFF by pressing the CONTRA ON/OFF softkey.

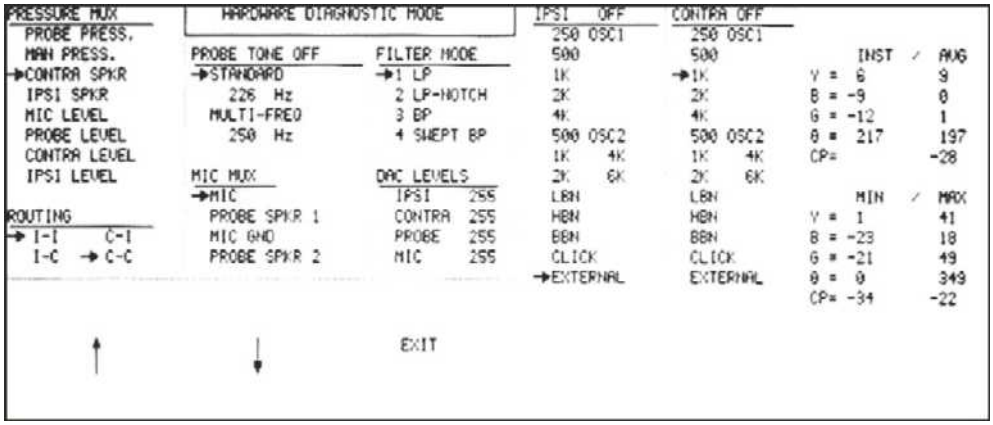
MUX INPUTS

The desired PRESSURE MUX or MIC MUX input can be selected for measurement by pressing the MUX INPUTS softkey. The MUX Input menu will be displayed at the bottom of the LCD.



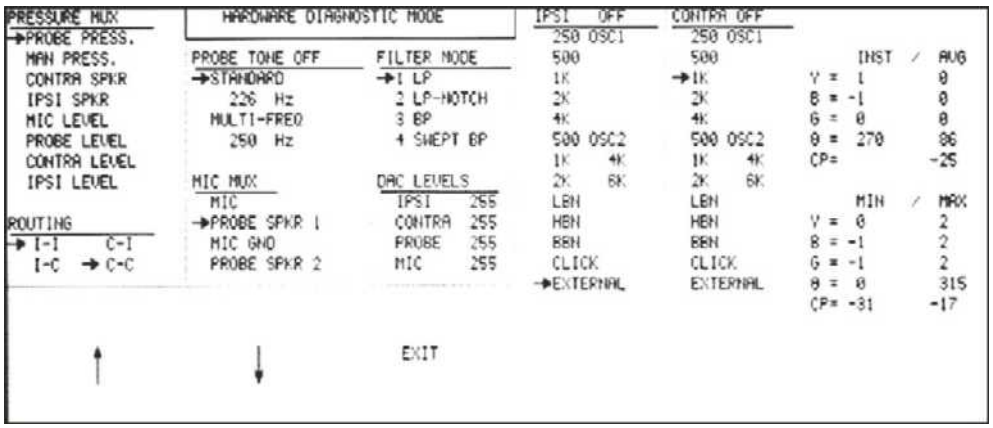


Pressing the PRESSURE MUX or MIC MUX softkey displays UP and DOWN ARROW softkeys that can be used to select a MUX source.



The PRESSURE MUX sources are shown in the upper-left portion of the LCD. This example shows the CONTRA SPKR source selected as the input for the PRESSURE MUX.

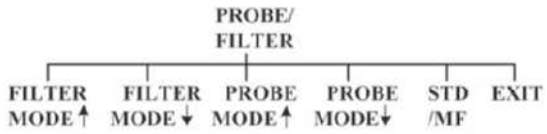
The MIC MUX sources are shown in the center-left portion of the LCD. This example shows the PROBE SPKR1 source selected as the input for the MIC MUX.

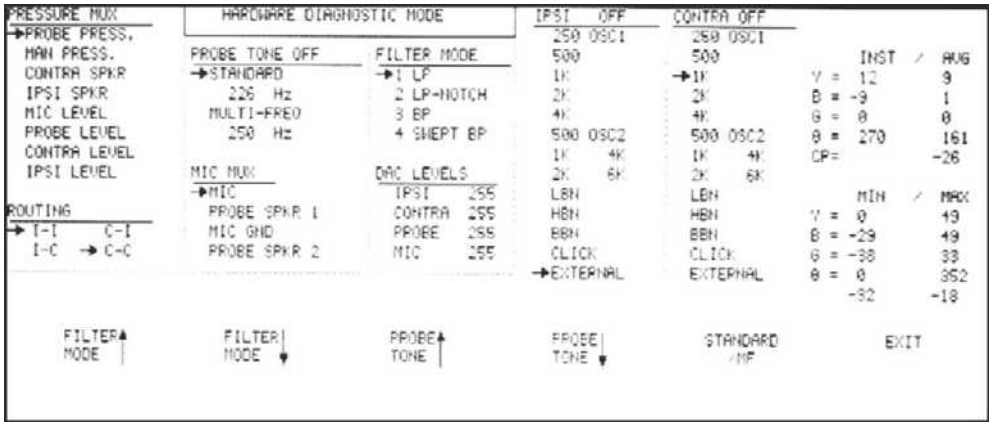


Pressing the EXIT softkey displays the MUX input menu again. Pressing the RETURN hardkey displays the Hardware Diagnostic Mode menu.

PROBE/FILTER

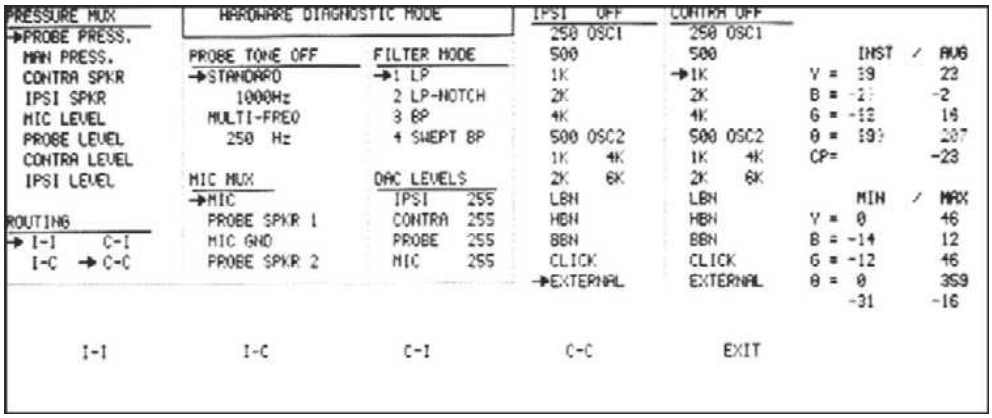
The probe output tone and input filter mode can be selected by pressing the PROBE/FILTER softkey. The output can also be toggled between standard and multi-frequency tones. The PROBE/FILTER menu will be displayed.



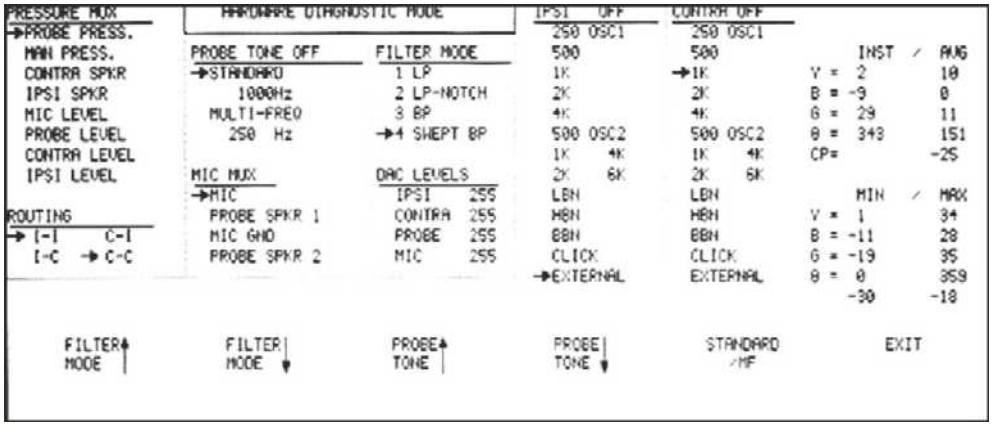


Selected probe tones are displayed in the PROBE TONE list in the center-left of the LCD, and can be changed for standard and multi-frequency tones by pressing the PROBE TONE UP and DOWN NO CAPS.

The probe tone can be toggled between STANDARD and MULTI-FREQ by pressing the STANDARD/MF softkey. This example shows a standard probe tone of 1000 Hz selected.



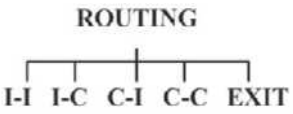
Selected input filters are displayed in the FILTER list in the center of the LCD, and can be changed by pressing the FILTER MODE UP and DOWN NO CAPS. This example shows a filter mode of 4 SWEPT BP selected.



Pressing the EXIT softkey displays the Hardware Diagnostic Mode menu.

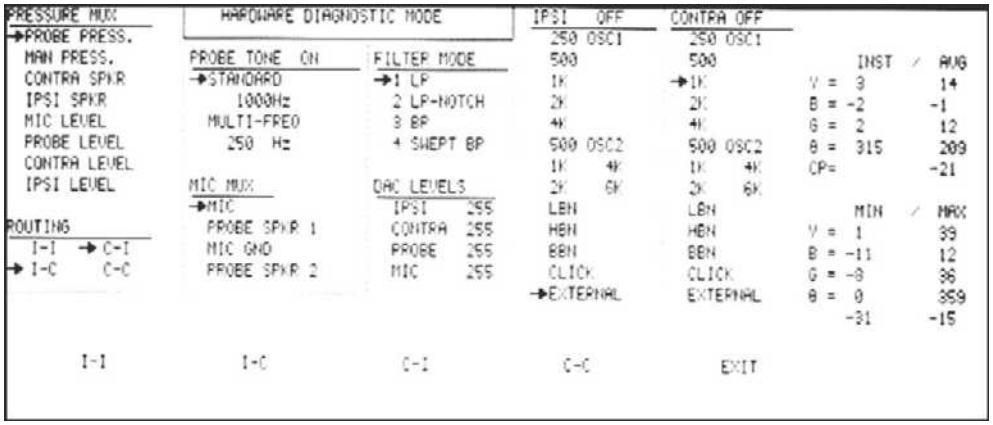
ROUTING

Output signal routing for IPSI and CONTRA channels by pressing the ROUTING softkey. The Routing menu will be displayed.



The desired channel routing can be selected by pressing the corresponding softkey, as shown below:

I – I: IPSI channel to IPSI transducer
I – C: IPSI channel to CONTRA transducer
C – I: CONTRA channel to IPSI transducer
C – C: CONTRA channel to CONTRA transducer



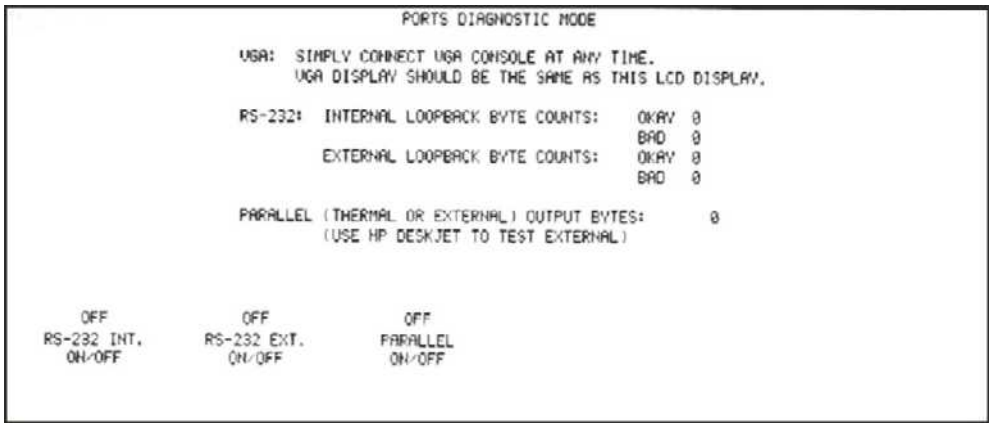
Pressing the EXIT softkey displays the Hardware Diagnostic Mode menu.

PROBE ON/OFF

The probe tone output can be toggled on and off by pressing the PROBE ON/OFF softkey.

PORTS DIAG.

The internal and external RS-232 ports and the parallel port can be tested by pressing the PORTS DIAG softkey. The Ports Diagnostic mode screen will be displayed.



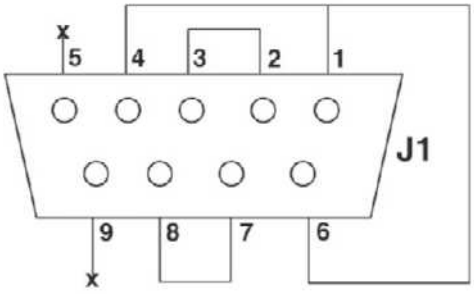
Test results are displayed in the center of the LCD.

RS-232 INT. ON/OFF

Pressing the RS-232 INT. ON/OFF softkey toggles the loopback test sequence for the internal RS-232 port on or off. Data is sent to the port, looped back and compared to the original output. Good and bad data counts are accumulated until the test is stopped by pressing the RS-232 INT ON/OFF softkey again.

RS-232 EXT. ON/OFF

Pressing the RS-232 EXT ON/OFF softkey toggles the loopback test for the external port on or off. Loopback testing of the external RS-232 port requires the use of a male RS-232 loopback connector. The connector wiring is shown here. The TympStar is DCE relative to RS232 data flow.



Rear view of male connector

Plug the loopback connector into the RS-232 port on the Tympstar rear panel, and press the RS-232 EXT ON/OFF softkey to begin the test. Good and bad data counts are accumulated until the RS-232 EXT ON/OFF softkey is pressed again.

PARALLEL ON/OFF

Pressing the PARALLEL ON/OFF softkey toggles the parallel port test on or off. When an external printer is connected to the TympStar parallel port, test data will be printed on the external printer. When no external printer is connected, test data is printed on the internal thermal printer.

In either case, the test will continue sending data to the printer until the PARALLEL ON/OFF softkey is pressed again. An example of the printed test data is shown below.

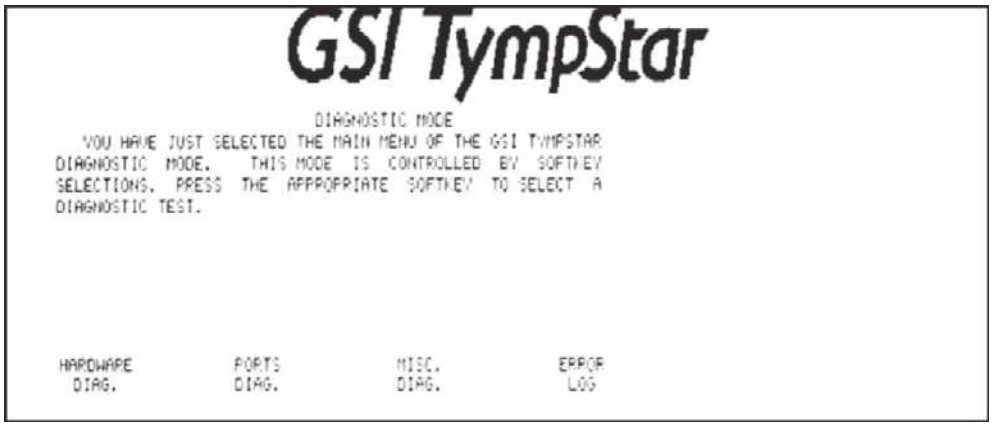
```
↑↓◄►─|°∆⌂□□□□□□□□□□□□□□□□□□□□□□□□ !"#$%&'()*+,-./012
3456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcd
efghijklmnopqrstuvwxyz{|}~ □□□□□□□□□□□□□□□□□□□□□□□□
□□□□□□□□□□ ¡¢£¤¥¦§¨©ª«¬-®¯°±²³´µ¶•¸¹º»¼½¾¿ÀÁÂÃÄÅÆÇÈ
ÉÊËÌÍÎÏÐÑÒÓÔÕÖ×ØÙÚÛÜÝÞßàáâãäåæçèéêëìíîïðñòóôõö÷øùú
ûüýþ
```

NOTE

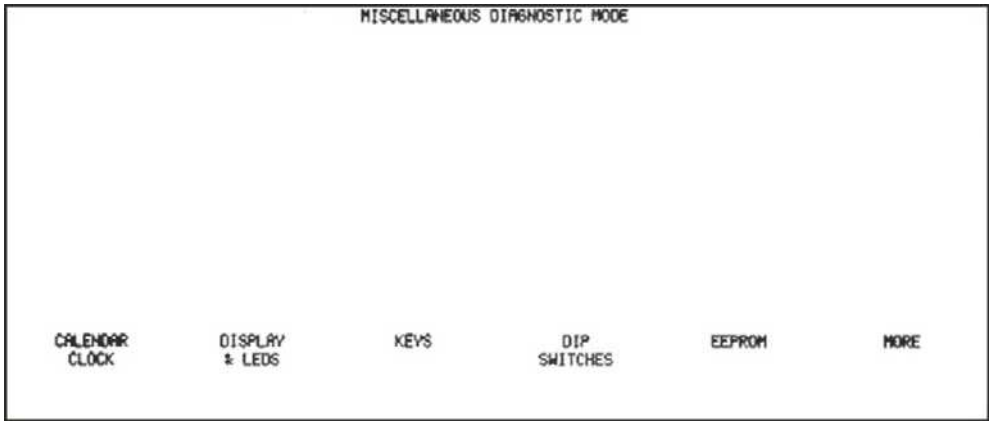
Any two or all of the PORTS DIAG tests can be conducted simultaneously. Pressing the RETURN hardkey displays the Hardware Diagnostic Mode menu.

MISC. DIAG

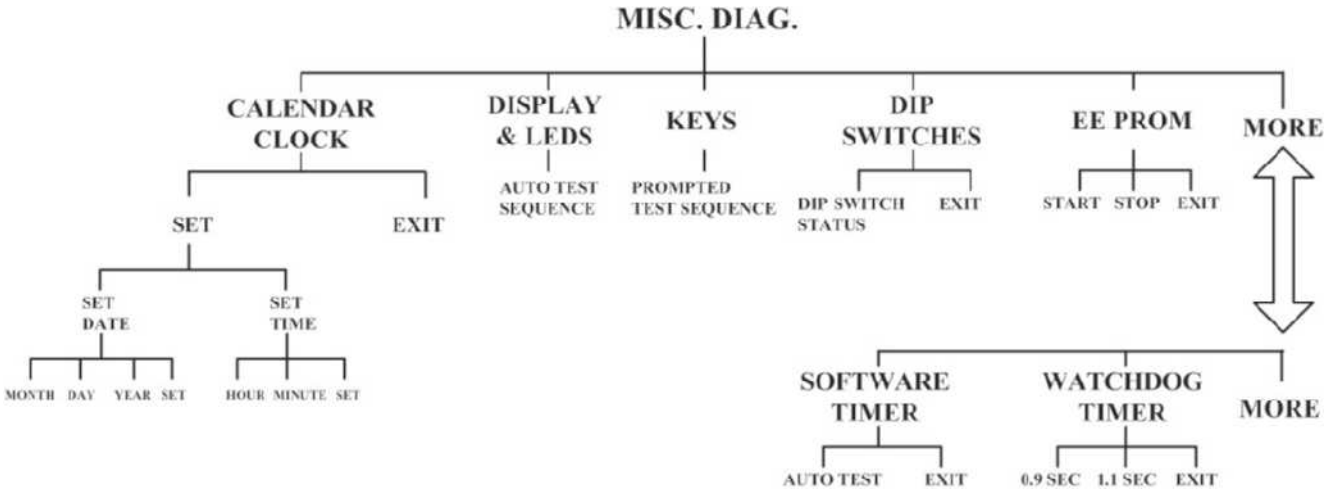
The miscellaneous diagnostics provide test functions for the display, probe LEDs, panel hardkeys and softkeys, DIPswitches, system EEPROM, software timer, and watchdog timer. The system calendar and clock can also be set from the MISC. DIAG menu.



Pressing the MISC. DIAG softkey displays the Miscellaneous Diagnostic Mode screen.

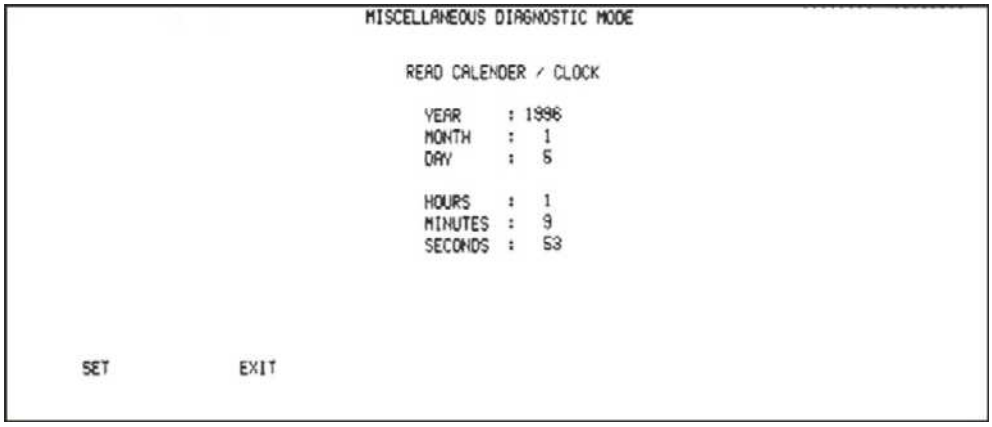


The MISC. DIAG menu is displayed above the softkeys at the bottom of the LCD.

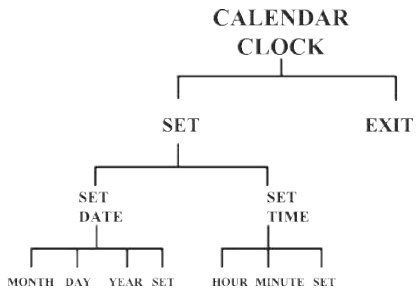


CALENDAR CLOCK

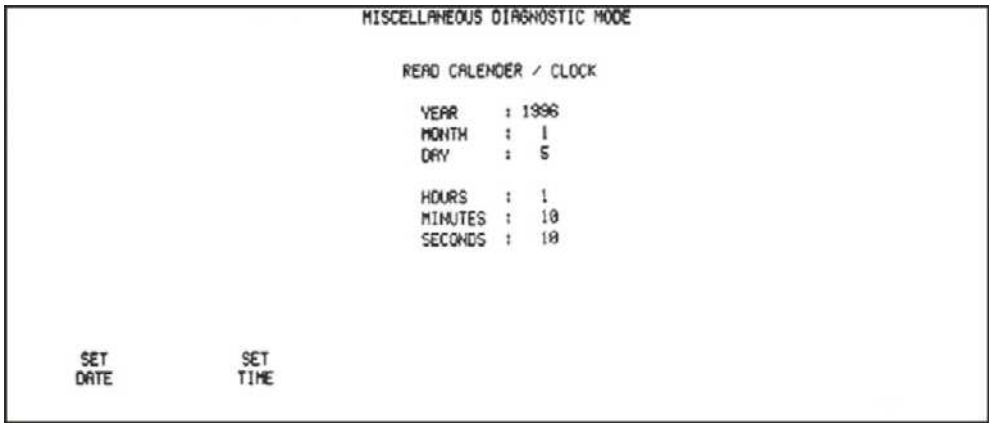
Pressing the CALENDAR CLOCK softkey displays the Calendar Clock screen.



Current date and time settings are shown at the center of the screen, and the Calendar Clock menu is displayed above the softkeys at the bottom.

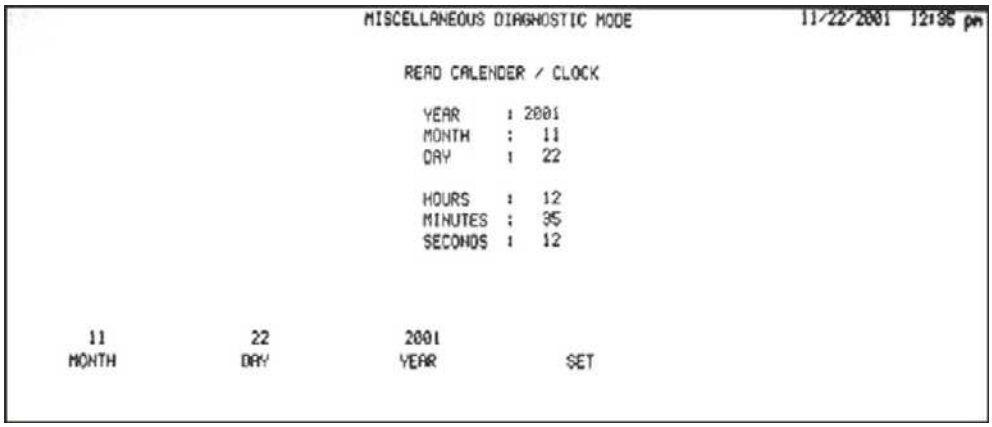


Pressing the SET softkey displays the Set Date/Time menu at the bottom of the LCD.

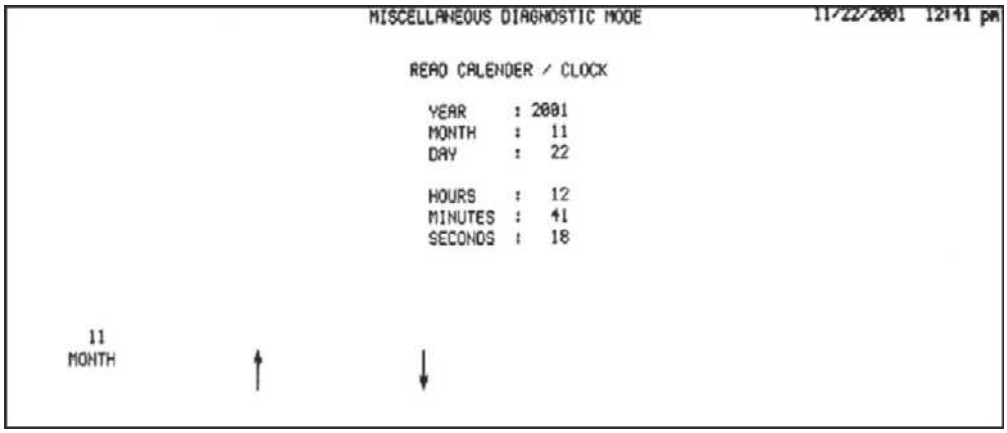


Pressing the SET DATE or SET TIME softkey displays the current settings for the date or time respectively across the bottom of the screen.

The example below shows date settings.



Pressing a setting category softkey such as MONTH or HOUR displays UP and DOWN NO CAPS for increasing or decreasing the setting value.



When the desired value is displayed, press the RETURN hardkey to display all of the date or time settings.

Pressing the SET softkey stores the current date or time settings in system memory, and returns to the Set Date/Time menu.

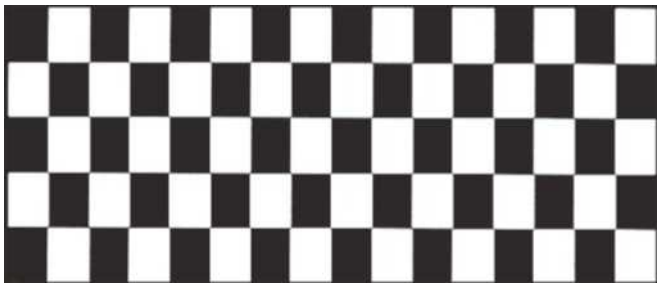
Pressing the RETURN hardkey, then the EXIT softkey displays the MISCELLANEOUS Diagnostic menu.

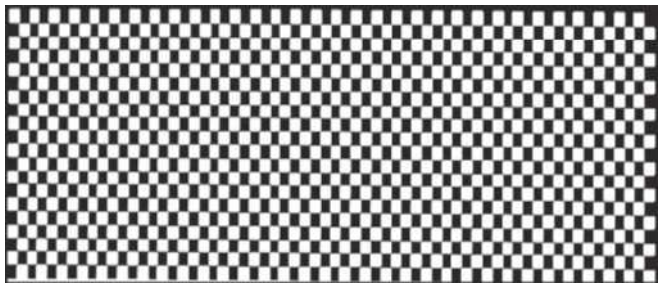
DISPLAY & LEDS

Pressing the DISPLAY & LEDS softkey starts an automatic test sequence that displays decreasing size checkerboard patterns on the LCD and flashes the probe box LEDs.

The LCD pattern automatically progresses through the following sequence:

- LCD is all black
- LCD is all white
- LCD is a checkerboard. Black on white squares, then white on black squares. The checkerboard pattern automatically decreases in size until the test is complete.

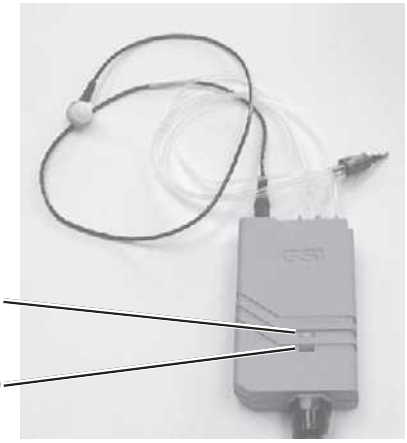




The probe box LEDs illuminate as follows:

LCD is all black: Green LED is ON
LCD is all white: Orange LED is ON
LCD is checkerboard: Repeating pattern:
3 Green flashes, then
1 Orange Flash

Upon conclusion of the test, the Miscellaneous Diagnostic menu is displayed.



KEYS

Pressing the KEYS softkey displays instructions in the center of the screen, and starts a test sequence that displays hardkey or softkey activations on the LCD.

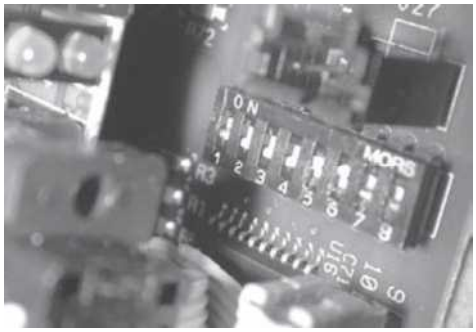
Pressing and holding any hardkey or softkey causes the system to display the name of the key, and to indicate that it is pressed.

Releasing the key changes the display to indicate that the hardkey or softkey was released.

Pressing the EXIT softkey three times in rapid succession ends the test and displays the Miscellaneous Diagnostic menu.

DIP SWITCHES

Pressing the DIP SWITCHES softkey displays the current settings of the Cal options DIP switch on the LCD.



The DIP switch settings can be changed and verified on the LCD.

```
                    MISCELLANEOUS DIAGNOSTIC MODE

                    DIP SWITCHES

                    TOGGLE EACH DIP SWITCH AND VERIFY BELOW.

                        DIP SWITCH #    1 2 3 4 5 6 7 8
                        STATE READ      1 1 1 1 1 0 1 1


    EXIT
```

WARNING
Do not touch any wires, circuitry or components in the Tympstar enclosure directly, or with conductive tools. AC power present in the enclosure can cause serious injury or death.

Pressing the EXIT softkey displays the Miscellaneous Diagnostic menu.

EEPROM

Pressing the EEPROM softkey displays a sequence of serial EEPROM test addresses and test results.

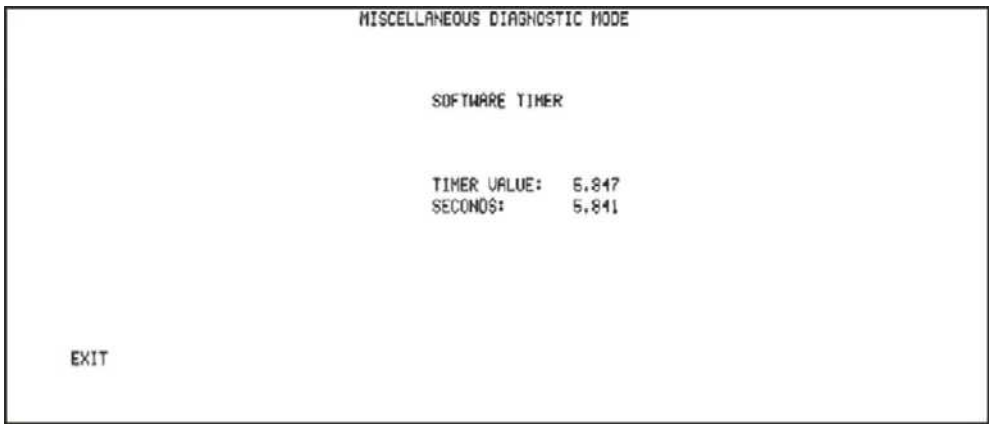
```
                    MISCELLANEOUS DIAGNOSTIC MODE

                        SERIAL EEPROM TEST

                          ADRESS:   0x001A

                          EXPECTED:
                          ACTUAL:

                          BLOCK SIZE =  0x02 BYTES


    START          STOP          EXIT
```

Pressing the START softkey initiates a test sequence that evaluates an incrementing series of memory locations by writing to and reading from each location in the series. The test continues looping through memory addresses until the test fails, or the STOP softkey is pressed. If the test fails, the address, expected contents, and actual contents of the problem memory location are displayed.

Pressing the STOP softkey halts the test. Pressing the EXIT softkey displays the Miscellaneous Diagnostic menu.

SOFTWARE TIMER

Pressing the SOFTWARE TIMER softkey displays the software timer test results and starts an automatic timer test.
The software timer test confirms correct processor instruction execution by using



the processor clock and a software instruction loop to count to approximately 10 seconds.

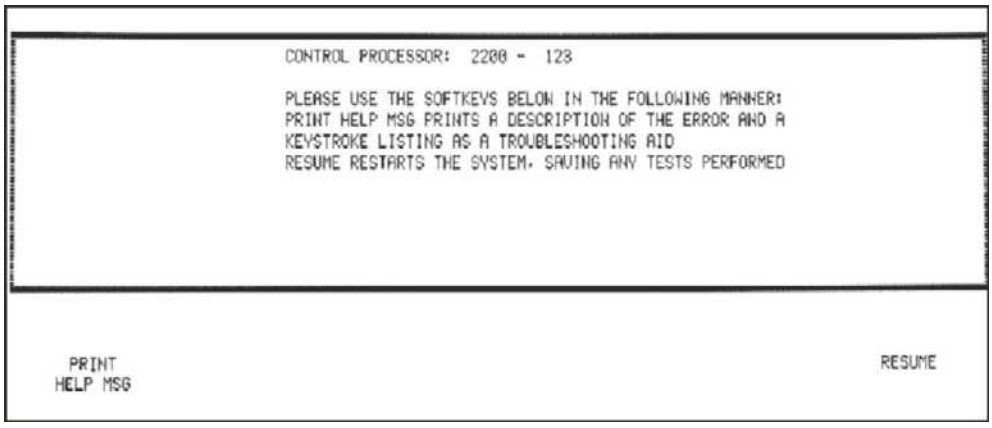
Upon conclusion of the test, the timer value is compared to the actual elapsed time, and a pass/fail indication is displayed.
Pressing the EXIT softkey displays the Miscellaneous Diagnostic menu.

WATCHDOG TIMER

Pressing the WATCHDOG TIMER softkey displays the watchdog timer test instructions and test results.

Pressing the smaller time value softkey tests the system for premature watchdog timer triggering. The software timer should complete its cycle without triggering the watchdog timer error.

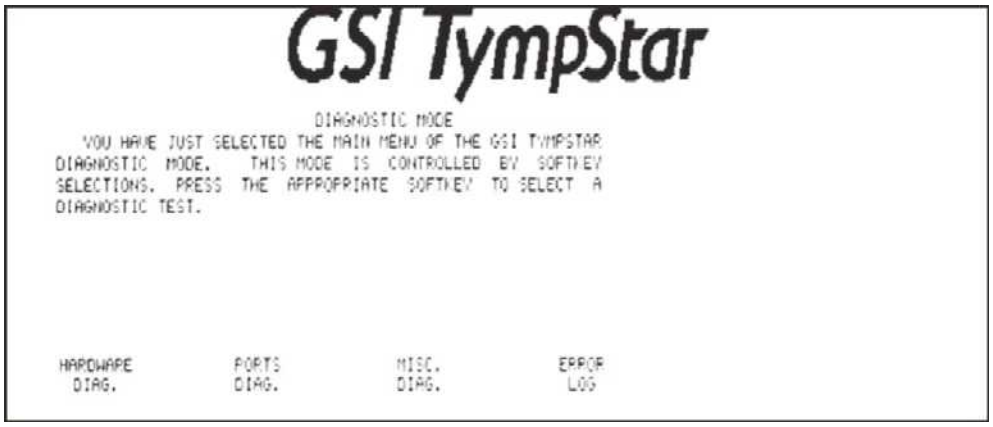
Pressing the larger time value softkey tests the system for watchdog timer failures. The software timer cycle is long enough to trigger the watchdog timer, and should trigger an error. When the error is triggered, an error message is displayed that contains instructions. Follow the instructions on the LCD to PRINT control information or RESUME operation.



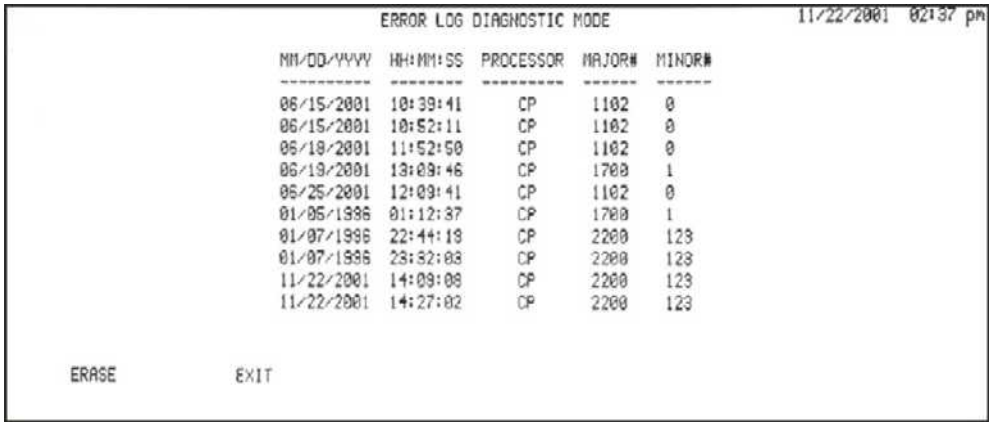
Pressing the RESUME softkey restarts the TympStar system and displays the Diagnostic Mode menu.

ERROR LOG

Pressing the ERROR LOG softkey displays a date/time-stamped log of errors.



The Error Log displays the processor, major error number and minor error number are listed.



Refer to Chapter 8: Troubleshooting for error descriptions.

Switch 7: Self-Cal

If this switch is in the ON position when the Cal mode is entered, the TympStar will perform a Self-Calibration. The Self-Cal automatically adjusts the probe tone frequencies to within plus or minus one percent of nominal and balances some microphone filters for proper linearity. Once Self-Cal is complete, all the pertinent calibration data is stored in the TympStar.

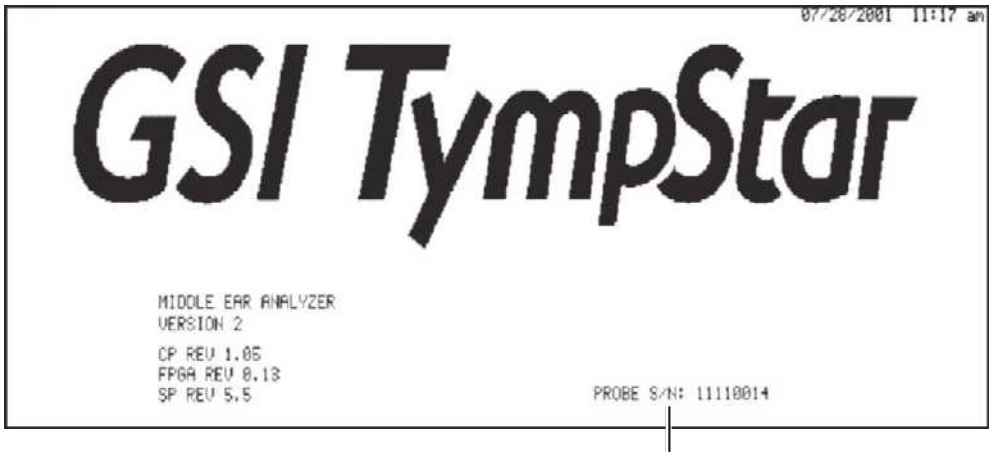
Switch 8: Load default calibration data

Default calibration data is stored by the TympStar and is used as a basis for calibrations. This data consists of operational parameters for stimulus SPL, compliance circuits, probe tone frequencies and microphone filters. When the Cal mode is entered with the switch in the ON position, softkeys will be displayed on the LCD providing a choice of default data that can be loaded.

CAUTION
Default data is not accurate for test measurements. It is only useful as a starting point for complete calibration. A Self-Cal followed by a complete system calibration must be performed after loading default data.

Probe serial number

The TympStar calibration can be performed only when the TympStar system is operating with the correct probe. The serial number of the correct probe is shown on the TympStar's initialization screen when power is applied to the system.



CAUTION
If the serial number shown on the initialization screen does not match the TympStar's probe serial number label, abort the calibration and contact GSI technical support.

Resolving problems

It is unlikely that you will encounter problems during calibration. However, if you are unable to meet a calibration objective at any point in the process you must take corrective action and start the process again from the beginning.

If you encounter a problem-
Check your equipment, test cavities and connections, and start over.

Still have a problem-
Clean the probe or Contra phone, check the probe tubes and start over.

Still have a problem-
Change the probe assembly and start over.

Still have a problem-
Contact your local GSI representative or GSI technical support.

Calibration procedures

TympStar calibration controls

The TympStar is calibrated using a combination of front panel hardkeys and LCD panel softkeys.

Hardkeys

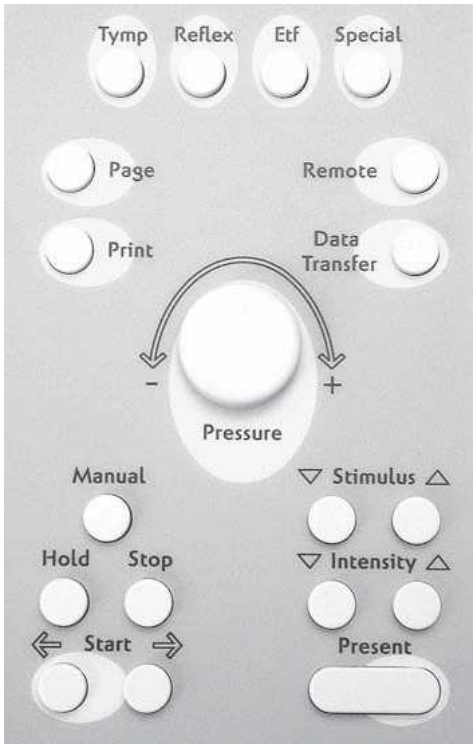
Hardkeys are used as follows:
Stimulus Up/Down arrows-
Scrolls up or down through available stimulus tone frequencies.

Intensity Up/Down arrows-
Adjusts output level of stimulus tone up or down in 0.5dB increments.

Present bar-
Toggles the stimulus tone on and off.

Data transfer key-
Stores currently displayed calibration values of tone frequency and level in the TympStar's memory.

Return key (LCD panel)-
Returns to previous (higher) level in the calibration menu hierarchy.



Softkeys

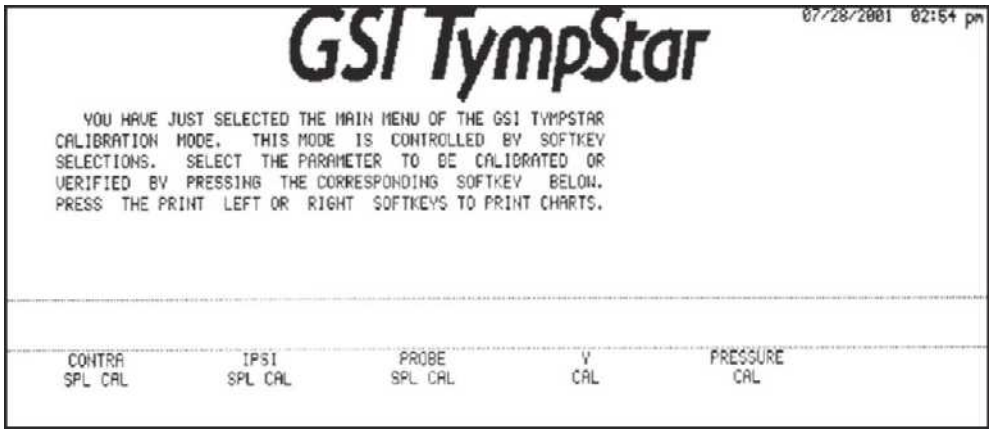
The softkey functions are displayed on the LCD above the softkeys. Softkey functions change to support the selected calibration test.

Softkeys are for the following functions :

- Select calibration functions from the Main Menu
- Navigate through specific calibration menus
- Print calibration data sheets or calibration instructions
- Adjust HL and target SPL levels

Selecting calibration functions:

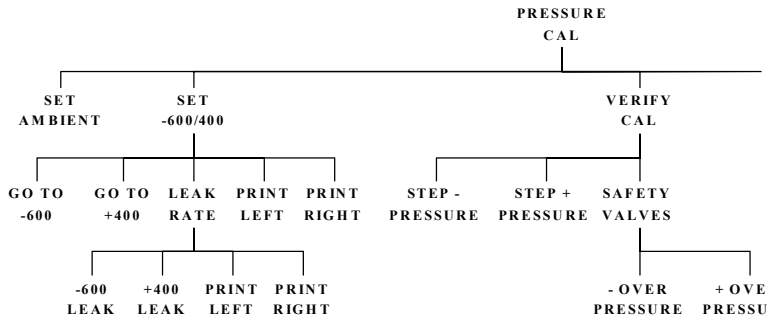
The Main Calibration Menu is displayed when the TympStar enters the Calibration Mode. The Version 1 Main Calibration Menu is shown below.



Calibration functions are shown across the bottom of the screen and can be selected by pressing the desired softkey.

Navigating menus:

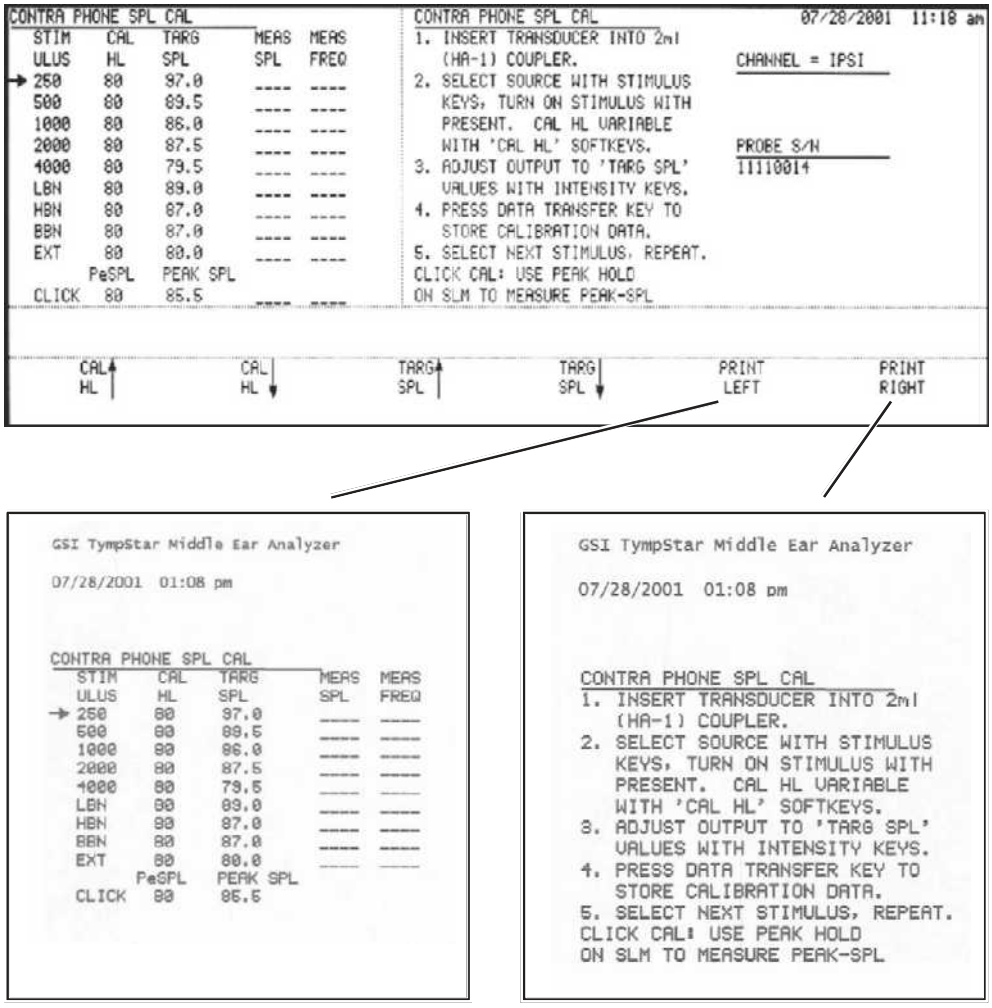
Each calibration test function is supported by a unique menu hierarchy of tests as illustrated by the Pressure Cal menu hierarchy shown below.



Pressing a softkey at one level causes the screen for the selected level to be displayed. Pressing the RETURN hardkey on the LCD panel returns to the previous level.

Printing calibration sheets

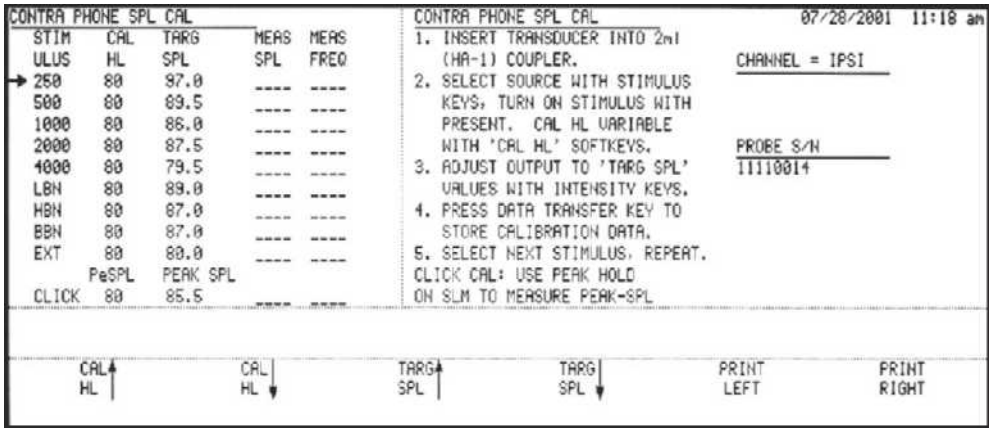
The screen contents can be printed at any time by pressing the PRINT LEFT or PRINT RIGHT softkey. Pressing PRINT LEFT prints the data content of the screen. Pressing PRINT RIGHT prints the calibration instructions shown on the screen.



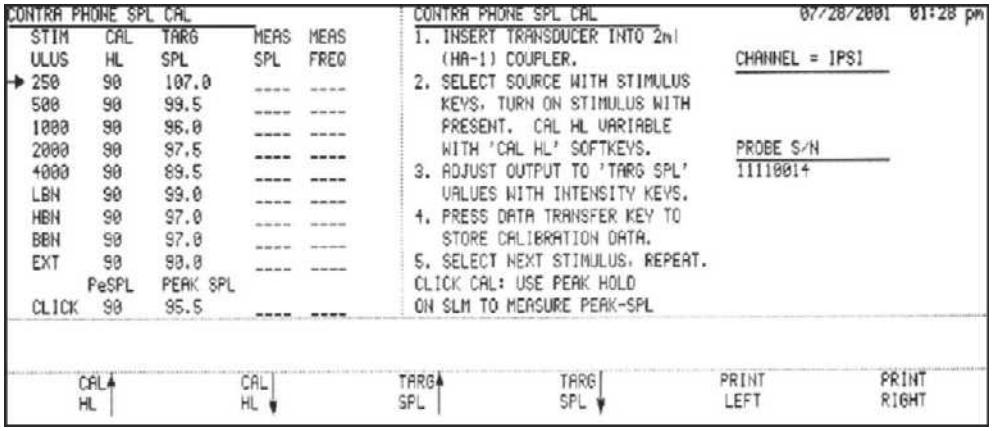
These screen printouts can be included in notebooks or calibration reports.

Adjusting Cal HL and Target SPL levels

The Cal HL level shown on the CONTRA SPL CAL and IPSI SPL CAL screens can be adjusted in 5.0dB increments to accommodate background noise levels in the calibration environment. As the Cal HL level is adjusted up or down, the TARG SPL level automatically tracks to eliminate the need for separate transducer target SPL adjustments.



80 dB HL changed to 90 dB HL



The TARG SPL level shown on the CONTRA SPL CAL and IPSI SPL CAL screens can only be adjusted when a custom transducer has been specified by setting switch #2 of the calibration options DIP switch to the ON position. The appropriate target SPL can be incremented up or down in 0.5dB increments for each probe tone frequency.

NOTE
Target SPL values must be within 10dB of the GSI default values.

Custom transducers

Custom transducers can be calibrated if the target SPL at each probe tone frequency is within 10dB of the GSI default value.

To set the target SPL of custom transducers:
Step 1
Set switch #2 of the calibration options DIP switch to ON when preparing for calibration. The up/down TARG SPL softkeys will then be active during calibration.

Step 2
Adjust the TARG SPL at each probe tone frequency to the required level during the calibration of CONTRA and IPSI SPL.

Step 3
When calibration is complete, enter the Normal Mode and verify that "NON-GSI" is displayed next to dBHL on the LCD.

Transducer connections

Transducers must be clean and completely inserted into the HA-1 coupler. Dirty transducers or incomplete insertions into the coupler will result in erroneous data.

Always insert the probe or contra phone transducer into the coupler so that no gap exists between the main body of the transducer and the coupler. The example below shows the contra phone incorrectly and correctly inserted into the coupler.

Gap: Incorrect

No Gap: Correct

TympStar Version 1 Calibration

This section contains the following:

- Calibration requirements
  - Complete calibration sequence
  - Routine calibration sequence
- Calibration procedures
  - Loading default data and Self-Cal
  - Contra, Ipsi and probe tone calibration
  - Y calibration
  - Pressure system calibration

Calibration requirements

Calibration is typically performed as a complete calibration sequence or as a routine calibration sequence.

Complete calibration sequence

A complete calibration sequence must be performed if the following:

- A performance problem is suspected
- A repair has been made to the TympStar involving the digital board, analog board, PC104 board, probe box or transducers

The complete calibration sequence must include the following:

- Loading default data and performing Self-Cal
- Contra, Ipsi and probe tone SPL calibrations
- Y calibration
- Pressure system calibration

Upon completion of a complete calibration sequence, return to the normal mode and check compliance calibration at 0 daPa. Then re-enter the Cal Mode and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

Routine calibration sequence

A routine calibration sequence should be performed quarterly or annually and in-Cludes the following:

- Checking the Contra, Ipsi and probe tone SPL calibration and recalibrating if necessary
- Performing Y calibration
- Checking the pressure system calibration and recalibrating if necessary

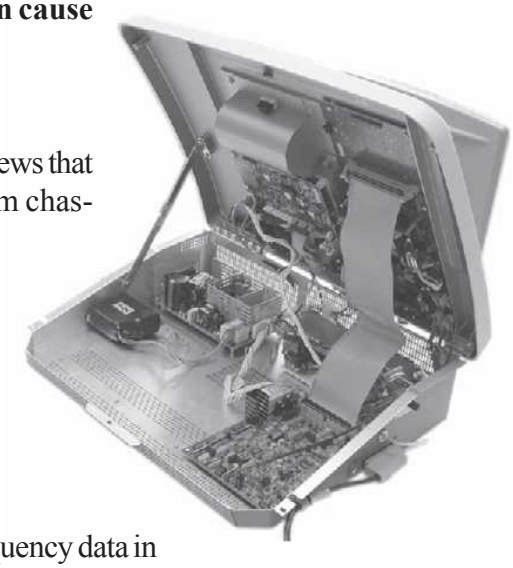
Upon completion of a routine calibration sequence, return to the normal mode and check compliance calibration at 0daPa. Then re-enter the Cal Mode and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

Version 1 Calibration Procedures

WARNING
Some calibration tasks will be performed while the instrument enclosure is open and power is applied. Do not touch wiring, circuitry or electrical components! Voltages are present within the instrument enclosure that can cause personal injury or death!

Remove the three retaining screws that secure the cover to the bottom chassis.

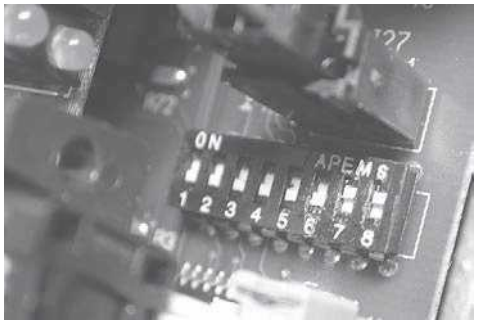
Lift the cover and lock the cover support struts in place.



Self-Cal

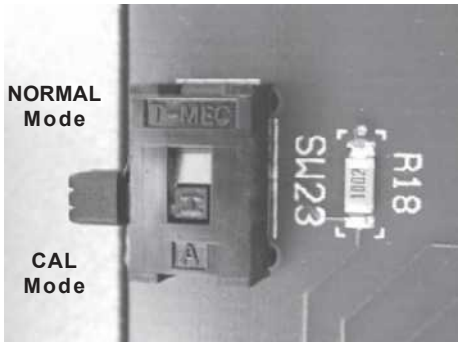
Self-Calibration stores new probe tone frequency data in the TympStar and must be performed if circuit boards contained within the instrument (digital board and analog board) are repaired. Self-Calibration is not required if only the probe is repaired or replaced.

Step 1
Operate positions 1, 2, 3, 4, 5 and 6 of the DIP switch on the digital board to OFF, and positions 7 and 8 to ON.



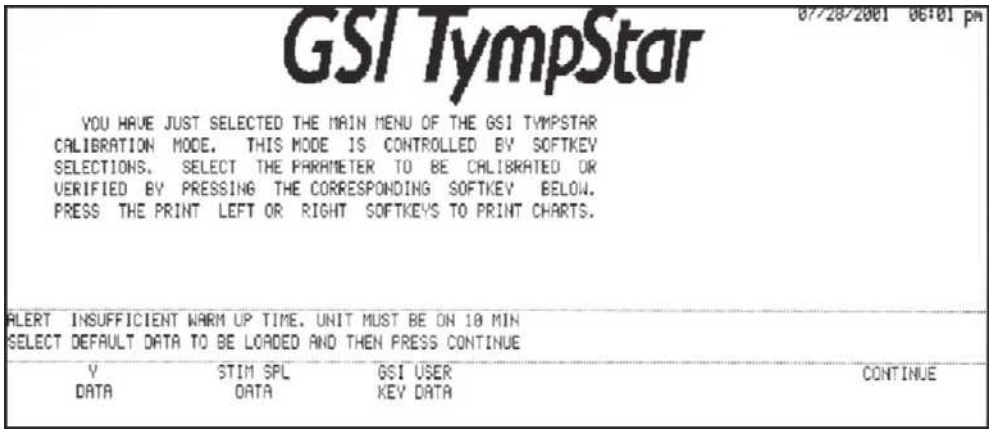
NOTE
Refer to page 4-32 to calibrate custom transducers.

Step 2
Operate the Cal/Normal switch on the upper left of the digital board to the CAL (down) position.



Step 3
Lower and close the cover.

The Main Menu screen of the Calibration Mode will be displayed with an alert message indicating the need for a 10-minute warm-up cycle. The default data choices will be displayed across the bottom of the screen.



Loading default data

Self-Calibration can be performed with or without loading default data. However, if the current calibration data is not close to acceptable values, the Self-Calibration process is likely to fail unless fresh defaults are loaded.

Default data must be loaded for a complete calibration sequence, or if a custom transducer is being calibrated.

The user can select which (if any) default data to load during calibration. The Y DATA is stored for probe tone frequencies and oscillator clock frequencies. The STIM SPL DATA is default data stored for the Ipsi and Contra transducers. The GSI USER KEY DATAis default data stored for the instrument function keys, such as pressure range and starting pressure.

NOTE
The user's unique key programming can be printed out from each test type by entering the program mode and then presing the PRINT hardkey. This feature can be used to return an instrument to the user settings should it become necessary to load default GSI user key data.

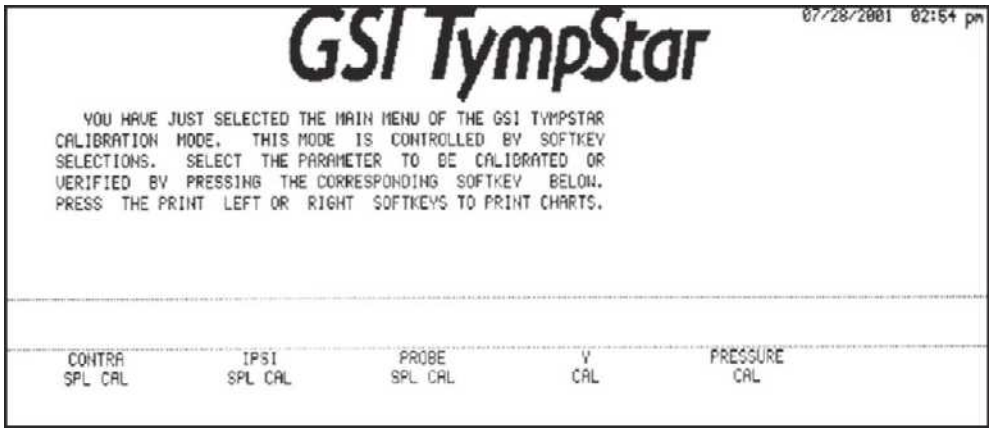
CAUTION
Loading new GSI USER KEY DATA will override any existing customer settings.

Step 4
Load default data if necessary, then press the CONTINUE softkey to perform the Self-Cal.

Upon completion of the Self-Cal, the system will proceed to the Main Calibration Menu screen.

Contra, Ipsi and Probe tone calibration

The calibration test functions are displayed across the bottom of the Main Calibration Menu screen.



NOTE

NOTE

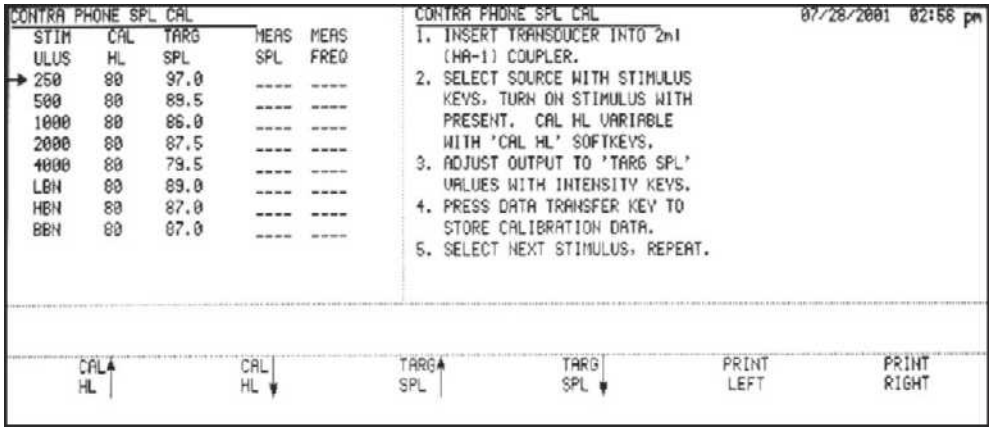
The system monitors output levels during these calibrations and alerts the user to levels that invalidate the calibration. These alerts appear when:

- **The stimulus is 5dB outside the acceptable sensitivity range of the transducer.**
- **The stimulus output voltage has reached its limit.**

Contra SPL Cal

Step 1

Press the CONTRA SPL CAL softkey. The CONTRA PHONE SPL CAL screen will be displayed.



Step 2

Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkey. The level can be adjusted up or down in 5.0dB increments.

Step 3 (Custom Mode only)

When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL up/down softkeys will be active.

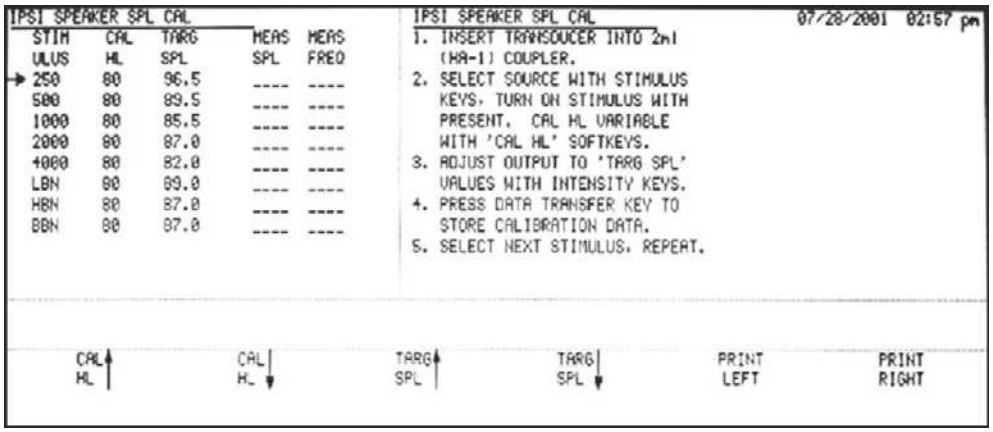
Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

Step 4
Follow the instructions on the screen until all stimulus calibrations are complete.

Step 5
Press the RETURN hardkey to return to the Main Calibration Menu.

Ipsi SPL Cal

Step 1
Press the IPSI SPL CAL softkey. The IPSI SPEAKER SPL CAL will be displayed.



Step 2
Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkeys. The level can be adjusted up or down in 5.0 dB increments.

Step 3 (Custom Mode only)
When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL softkeys will be active.

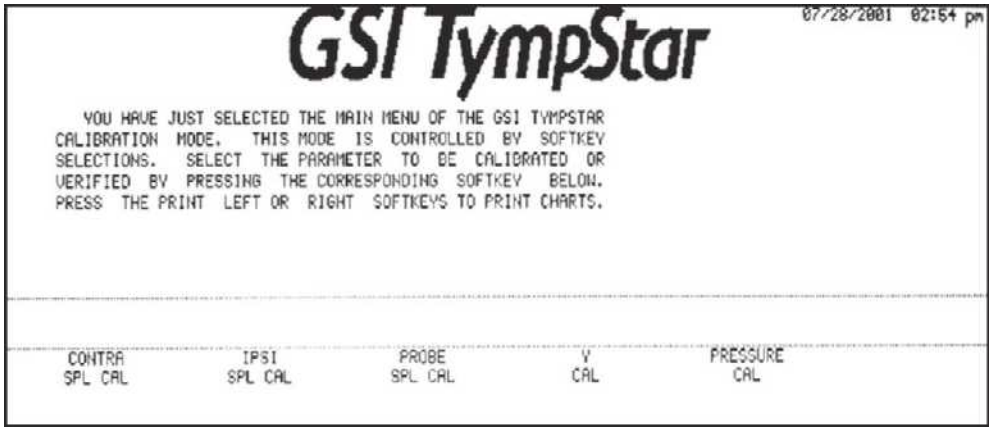
Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

Step 4
Follow the instructions on the screen until all stimulus calibrations are complete.

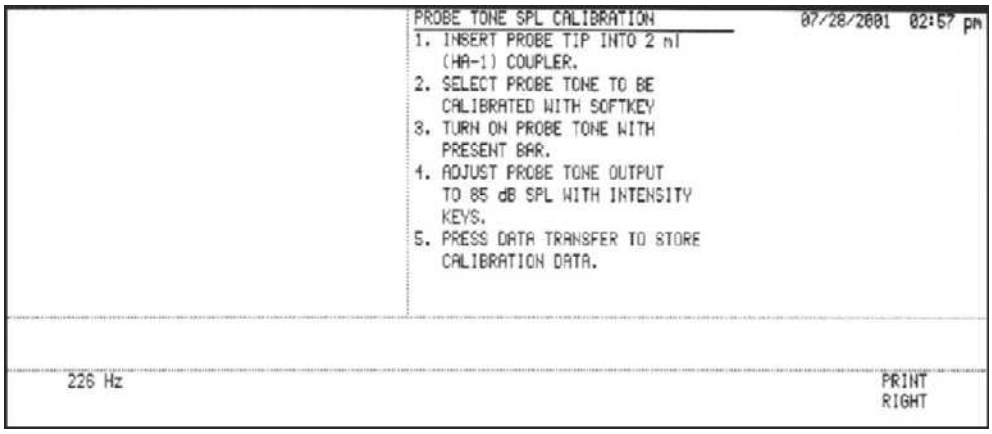
Step 5
Press the RETURN hardkey to return to the Main Calibration Menu.

Probe Tone SPL Cal

Step 1
Press the PROBE SPL CAL softkey.



The PROBE TONE SPL CAL screen will be displayed.

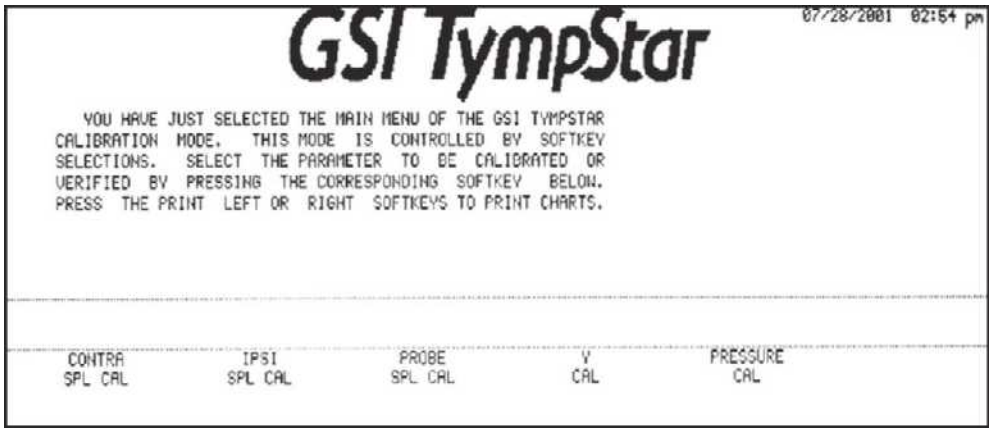


Step 2
Follow the instructions on the screen until the calibration is complete.

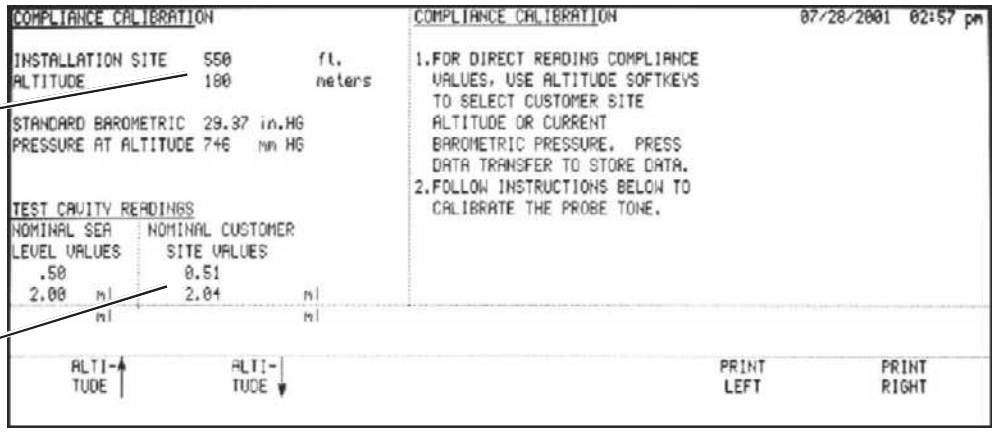
Step 3
Press the RETURN hardkey to return to the Main Calibration Menu.

Y Cal

Step 1
Press the Y CAL softkey.



The COMPLIANCE CALIBRATION screen will be displayed.



Altitude stored for your site

Equivalent (corrected) values

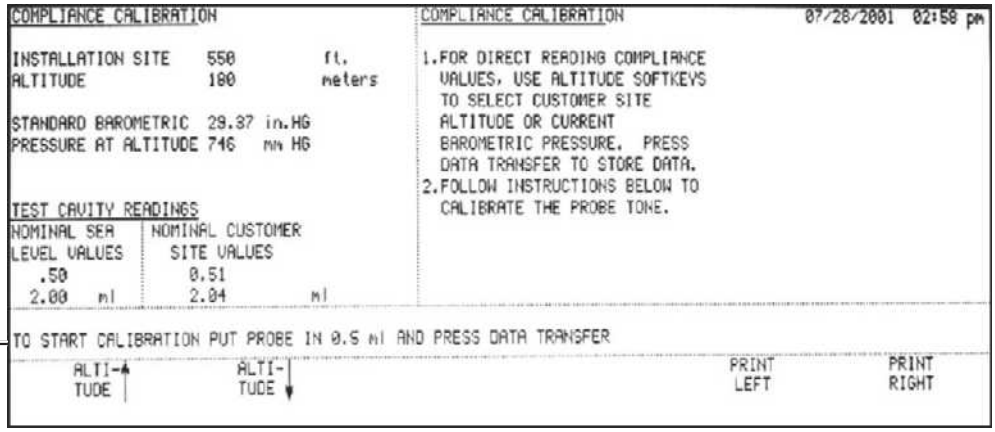
Altitude Cal

Altitude calibration is accomplished as an integral part of the Y Cal function.

Step 2
Verify that the altitude (elevation) displayed on the screen is correct for your site. If it is not, increase or decrease the value using the altitude up/down arrows. The altitude can be increased or decreased in 50-foot (16 meter) increments.

NOTE
You will not be allowed to return to the Main Calibration menu without Y calibration if the altitude was changed.

Step 3
Press the DATATRANSFER hardkey to continue. Additional calibration instruction will be displayed near the bottom of the screen.



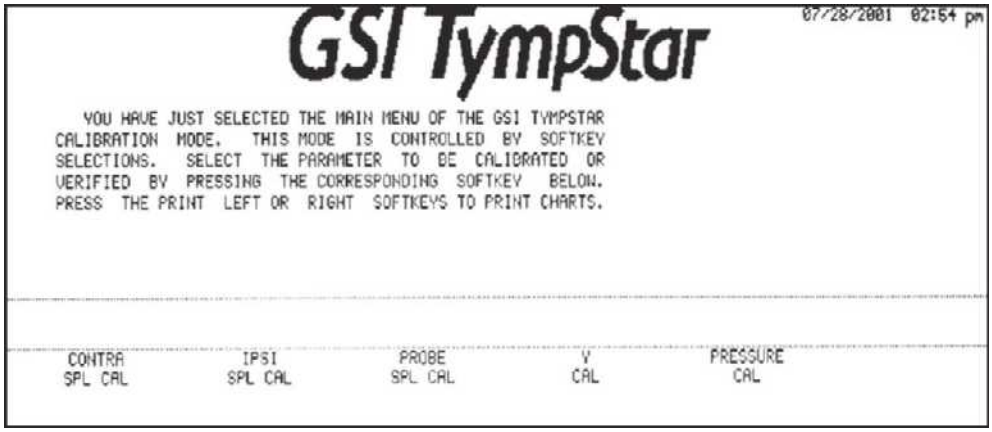
Instructions

Step 4
Follow the instructions on the screen until the calibration is complete.

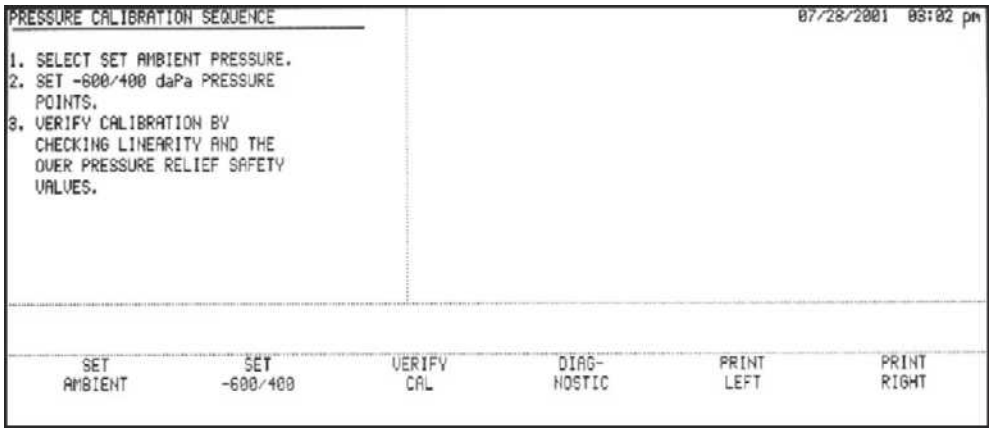
Step 5
Press the RETURN hardkey to return to the Main Calibration screen.

Pressure Cal

Step 1
Press the PRESSURE CAL softkey.



The PRESSURE CALIBRATION SEQUENCE screen will be displayed.

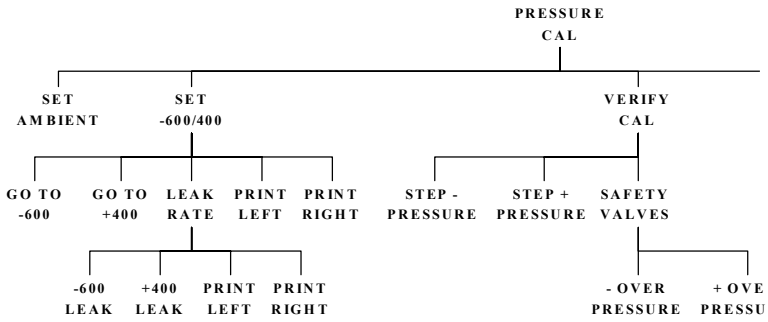


Pressure functions that can be calibrated or verified include the following:

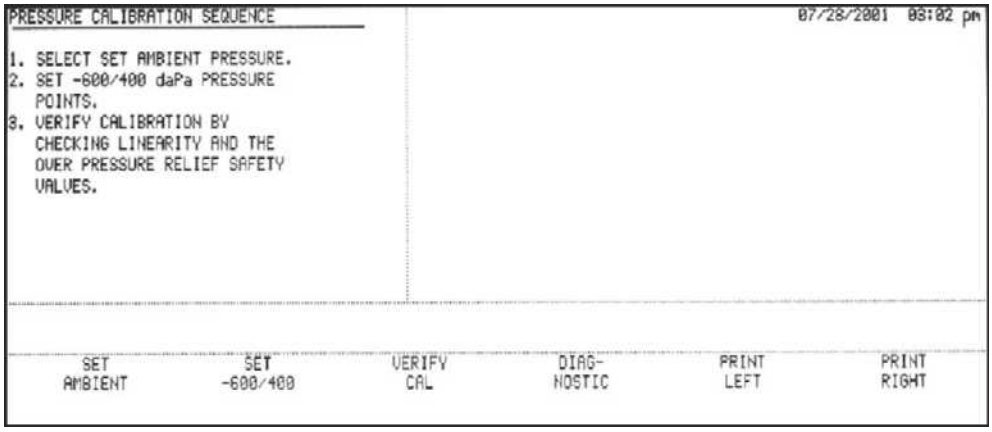
- Ambient pressure (0 daPa reference)
- Low and high-pressure limits (-600/+400)
- Pressure leak measurement
- Pressure linearity
- Safety valve operation

A diagnostic pressure control is also included.

The complete hierarchy of pressure calibration features (menu hierarchy) is shown Below in the following figure:

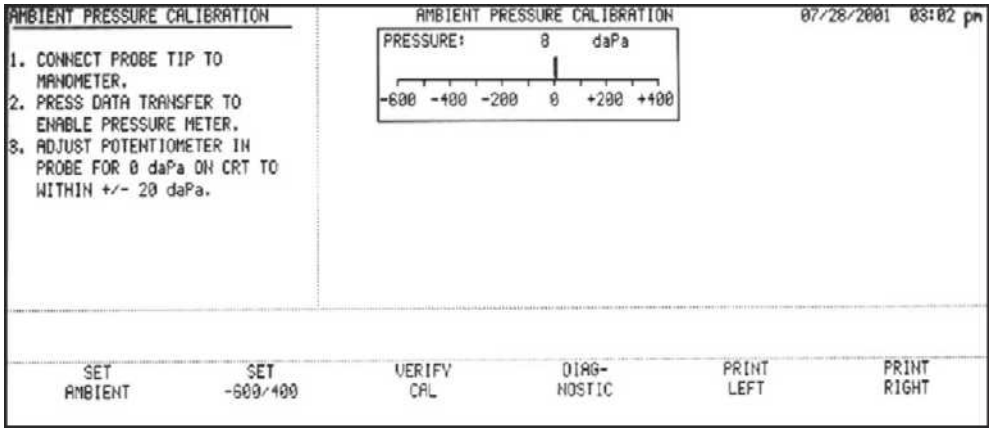


Press the desired softkey to access a pressure function.



Set ambient

Step 1
Press the SET AMBIENT softkey. The AMBIENT PRESSURE CALIBRATION screen will be displayed.

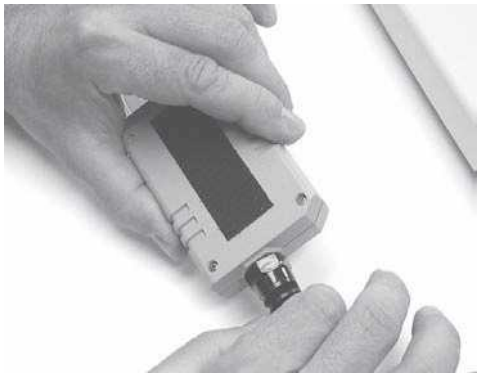


Step 2
Follow the instructions on the screen to measure the ambient pressure calibration using an electronic manometer. The manometer and LCD meter should agree within ± 10 daPa.

Adjusting the probe

Step 3
If it is necessary to adjust the probe's ambient pressure potentiometer:

- Loosen the cable strain relief by hand.
- Remove the two metal, and two nylon screws.

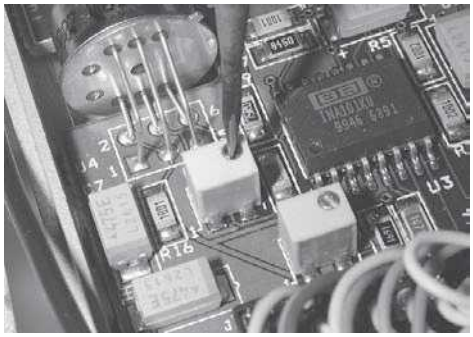


CAUTION
These screws must be reinstalled in the same positions later.

- Carefully remove the probe cover.

CAUTION
Do not disconnect the shield wire.

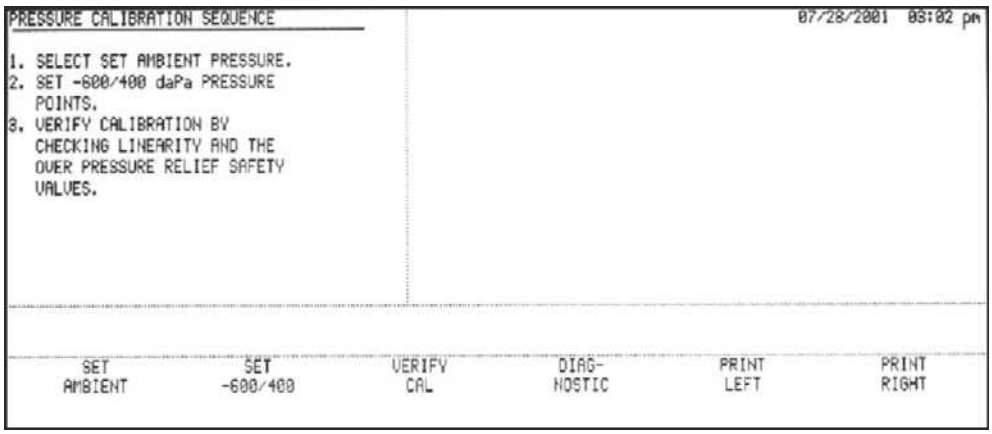
- Adjust the ambient potentiometer as shown to achieve an acceptable reading on the LCD meter.



Step 4
Proceed to the set -600/400 calibration function or reinstall the cover and press RETURN to return to the Main Calibration Menu.

Set -600/400

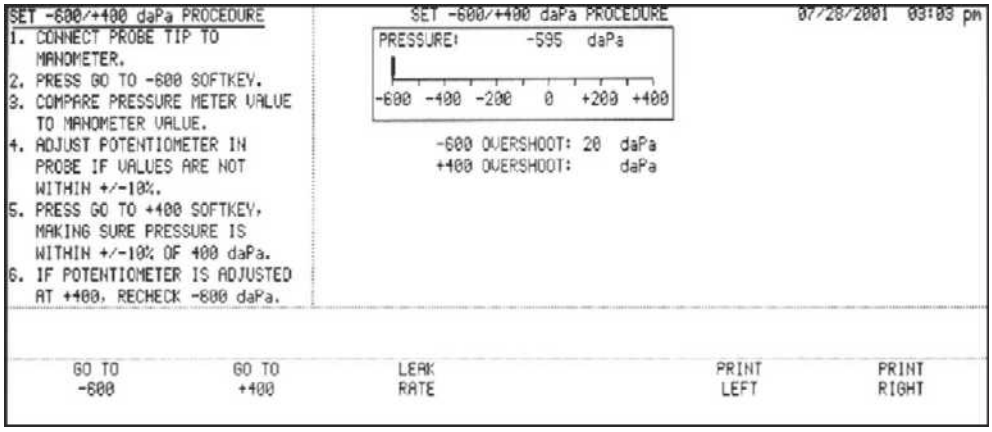
Step 1
Press the SET -600/400 softkey.



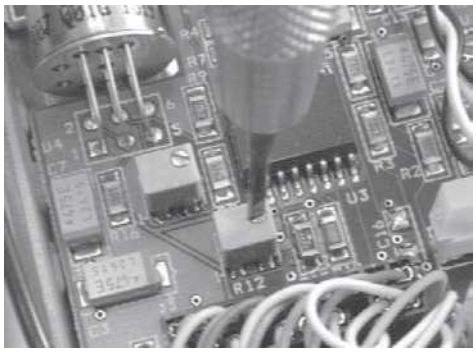
The SET -600/+400 daPa PROCEDURE screen will be displayed.

Step 2
Follow the instructions on the screen.

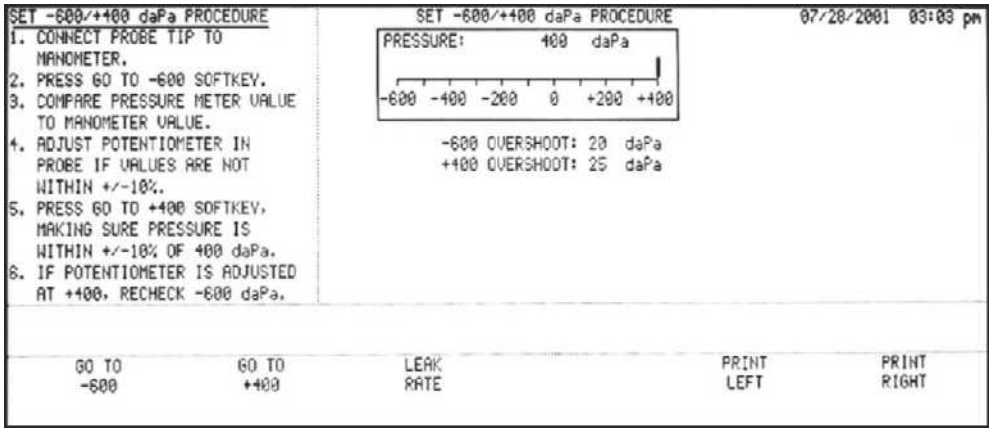
When the GO TO -600 softkey is pressed, the meter will display the current -600 daPa pressure. The manometer and LCD meter should agree within 10%.



Step 3
If the LCD meter is not within the required 10%, adjust the span potentiometer as shown until an acceptable reading is achieved.



Step 4
Press the GO TO +400 softkey. The meter will display the current +400 daPa pressure. The manometer and LCD meter should agree within 10%.



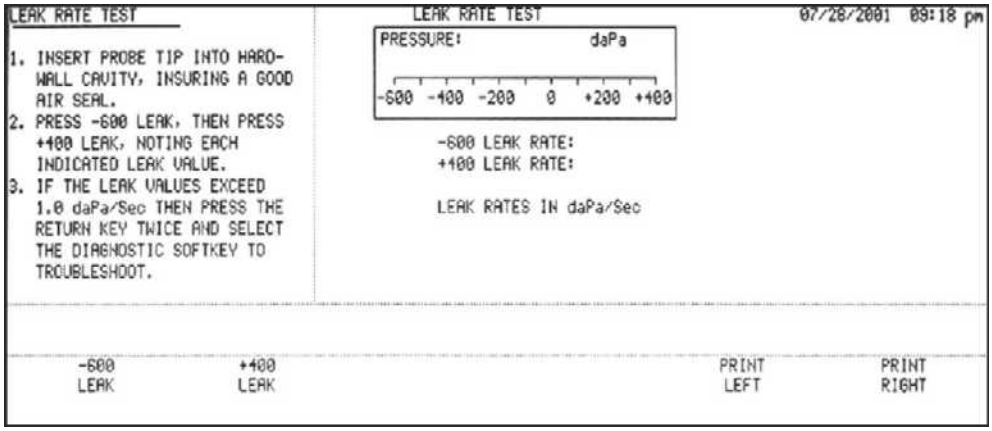
Step 5
If the LCD meter is not within the required 10%, adjust the span potentiometer to achieve an acceptable reading.

NOTE

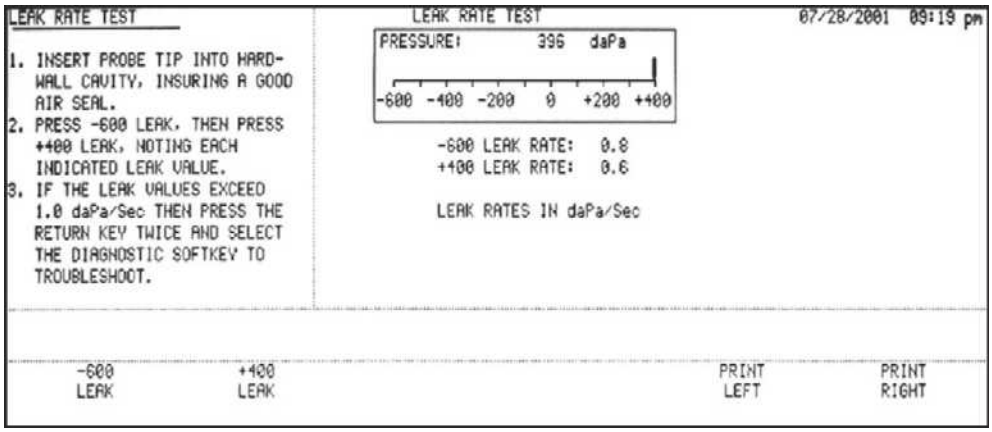
NOTE
The span potentiometer controls the -600 daPa and +400 daPa levels. Any adjustment at one pressure affects the other. The adjustment of -600 and +400 is sometimes an iterative process of adjusting one, then the other until both ends of the range are acceptable.

Leak rate

Step 1
Press the LEAK RATE softkey. The LEAK RATE TEST screen will be displayed.



Step 2
Follow the instructions on the screen to measure the -600 LEAK and +400 LEAK rates.



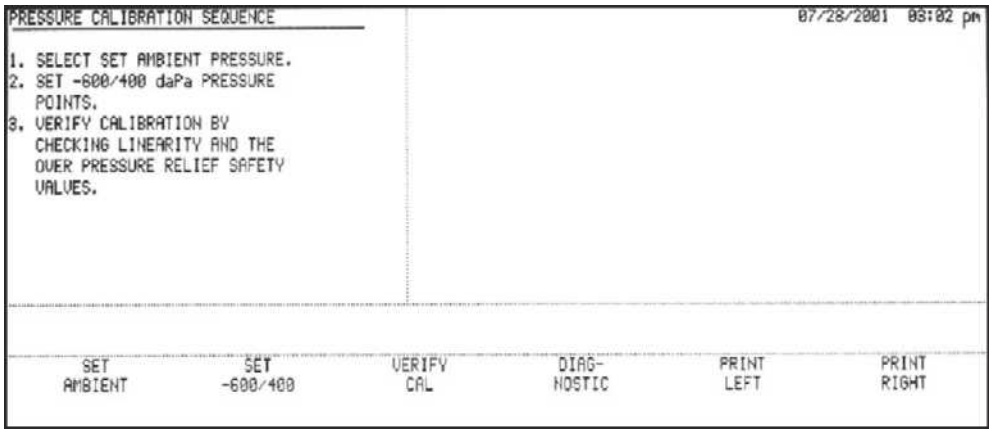
NOTE

If the leak rates are outside the 1.0 daPa limits, check the probe tubes, connections, and the cavity and cavity-sealing surface. Using the DIAGNOSTIC function can assist troubleshooting. Contact GSI technical support if you are unable to resolve the problem.

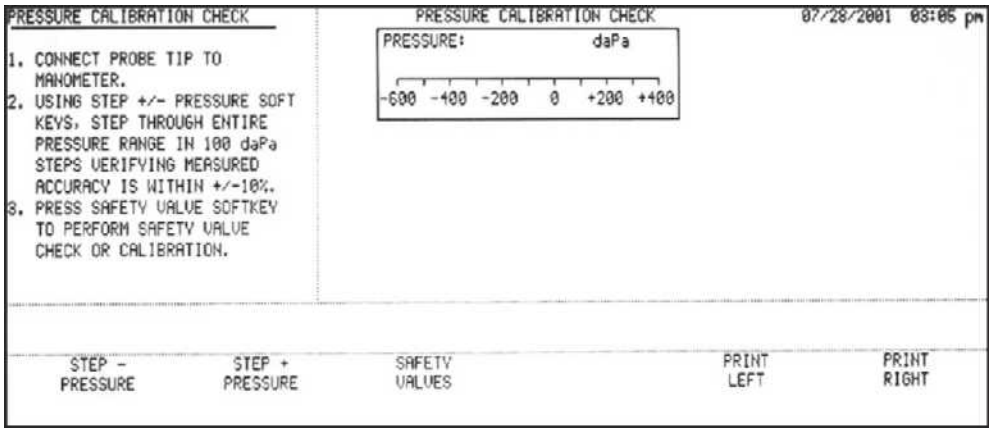
Step 3
Press the RETURN hardkey twice to return to the Pressure Calibration Menu.

Verify Cal

Step 1
Press the VERIFY CAL softkey.



The PRESSURE CALIBRATION CHECK screen will be displayed.

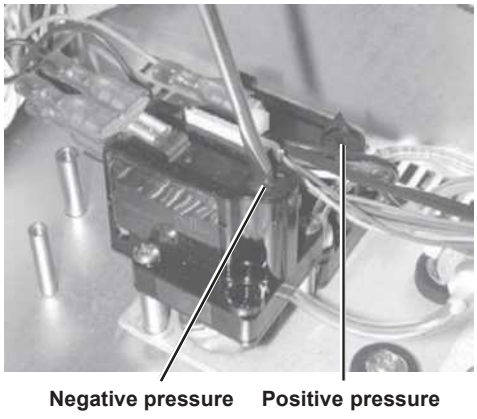


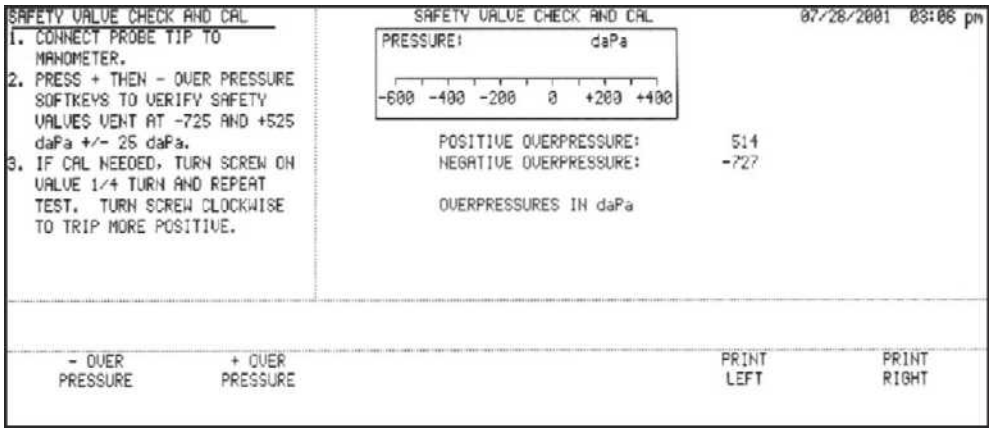
Step 2
Follow the instructions on the screen to verify the pressure range linearity and safety valve operation.

If the safety valve overpressure values fall outside the acceptable range, open the TympStar enclosure

WARNING
This adjustment is performed while the instrument enclosure is open and power is applied. Do not touch wiring, circuitry or electrical components! Voltages are present within the instrument enclosure that can cause serious personal injury or death!

- Adjust the safety valve to obtain satisfactory overpressure readings.

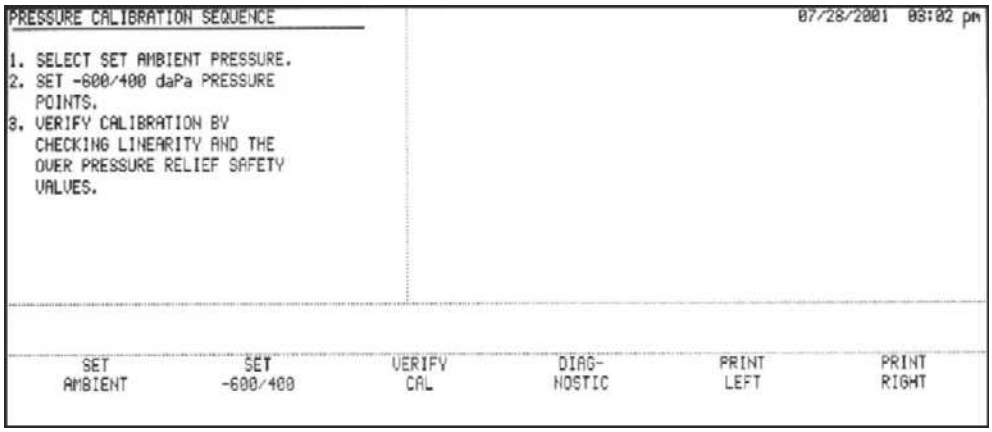




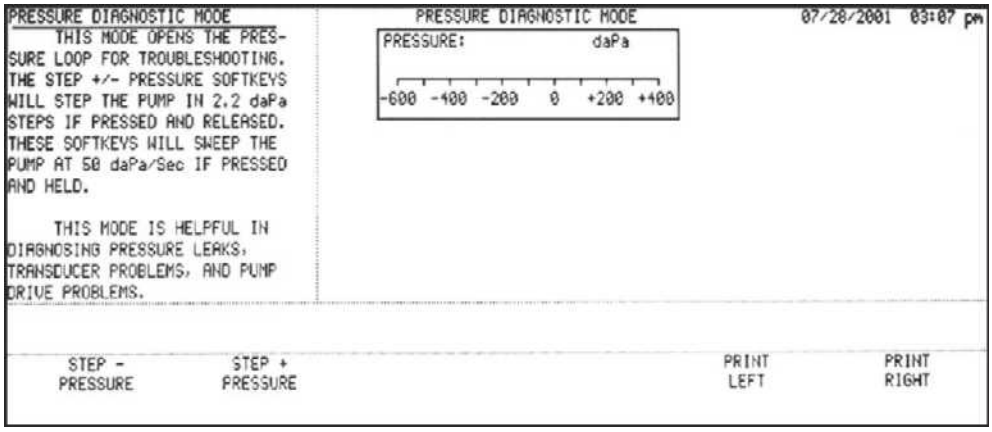
Step 3
Press the RETURN hardkey to return to the Pressure Calibration Menu.

Diagnostic

Step 1
Press the DIAGNOSTIC softkey.



The PRESSURE DIAGNOSTIC MODE screen will be displayed.



Use the diagnostic features to facilitate pressure system troubleshooting if necessary.

Step 2
Press the RETURN hardkey once to return to the Pressure Calibration Menu, or twice to return to the Main Calibration Menu.

Returning to the Normal Test Mode

When all calibrations have been completed:

- Set all switches of the Cal options DIP switch to OFF (down).
- Set the Cal/Normal switch to Normal (up).
- Verify that the probe and Contra phone are clean and ready for use.
- Close the cover and reinstall the three retaining screws.

TympStar Version 2 Calibration

This section contains the following:

- Calibration requirements
  - Complete calibration sequence
  - Routine calibration sequence
- Calibration procedures
  - Loading default data and Self-Cal
  - Contra, Ipsi and probe tone calibration
  - Y/B/G calibration
  - Pressure system calibration

Calibration requirements

Calibration is typically performed as a complete calibration sequence or as a routine calibration sequence.

Complete calibration sequence

A complete calibration sequence must be performed if the following occur:

- A performance problem is suspected
- A repair has been made to the TympStar involving the digital board, analog board, PC104 board, probe box or transducers

The complete calibration sequence must include the following:

- Loading default data and performing Self-Cal
- Contra, Ipsi and probe tone SPL calibrations
- Y/B/G calibration
- Pressure system calibration

Upon completion of a complete calibration sequence, return to the normal mode and check compliance calibration at 0 daPa. Then re-enter Cal Mode and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

Routine calibration sequence

A routine calibration sequence should be performed quarterly or annually and includes the following:

- Checking the contra, Ipsi and probe tone SPL calibrations and recalibrating if necessary
- Performing Y/B/G calibration
- Checking the pressure system calibration and recalibrating if necessary

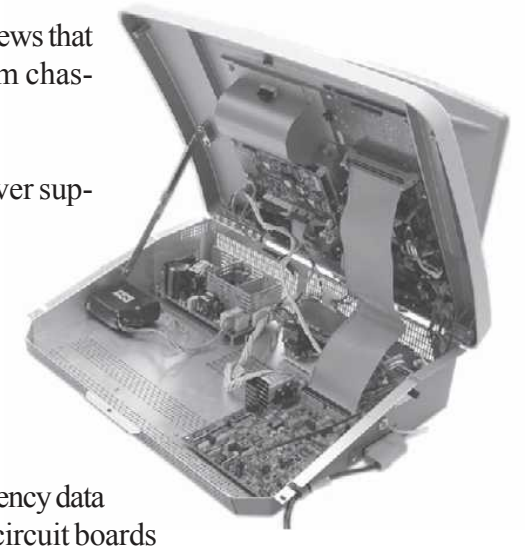
Upon completion of a complete calibration sequence, return to the normal mode and check compliance calibration at 0daPa. Then re-enter Cal Mode and verify that Ipsi and Contra sound pressure levels are within the specified accuracy. Attenuator linearity and distortion can also be checked in this mode.

Version 2 Calibration Procedures

WARNING
Some calibration tasks will be performed while the instrument enclosure is open and power is applied. Do not touch wiring, circuitry or electrical components! Voltages are present within the instrument enclosure that can cause personal injury or death!

Remove the three retaining screws that secure the cover to the bottom chassis.

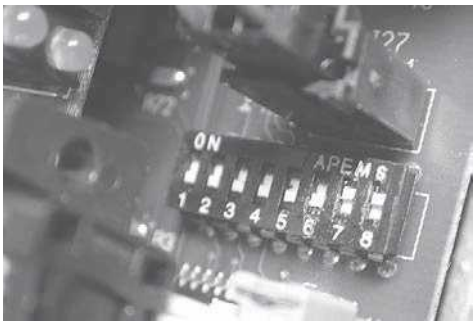
Lift the cover and lock the cover support struts in place.



Self-Cal

Self-Calibration stores new probe tone frequency data in the TympStar and must be performed if circuit boards contained within the instrument (digital board and analog board) are repaired. Self-Calibration is not required if only the probe is repaired or replaced.

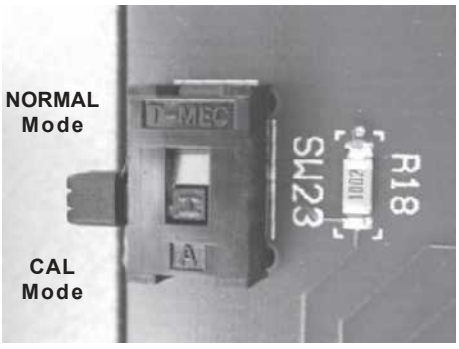
Step 1
Operate positions 1, 2, 3, 4, 5 and 6 of the DIP switch on the digital board to OFF, and positions 7 and 8 to ON.



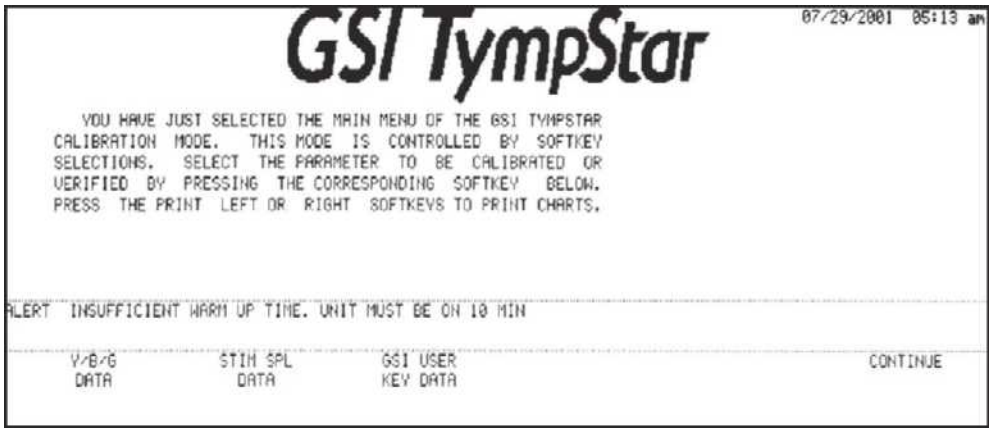
NOTE
Refer to page 4-32 to calibrate custom transducers.

Step 2
Operate the Cal/Normal switch on the upper left of the digital board to the CAL (down) position.

Step 3
Lower and close the cover.



The Main Menu screen of the Calibration Mode will be displayed with an alert message indicating the need for a 10-minute warm-up cycle. The default data choices will be displayed across the bottom of the screen.



Loading default data

Self-Calibration can be performed with or without loading default data. However, if the current calibration data is not close to acceptable values, the Self-Calibration process is likely to fail unless fresh defaults are loaded.

Default data must be loaded for a complete calibration sequence, or if a custom transducer is being calibrated.

The user can select which (if any) default data to load during calibration. The Y DATA is stored for probe tone frequencies and oscillator clock frequencies. The STIM SPL DATA is default data stored for the Ipsi and contra transducers. The GSI USER KEY DATAis default data stored for the instrument function keys, such as pressure range and starting pressure.

NOTE
The user's unique key programming can be printed out from each test type by entering the program mode and then presing the PRINT hardkey. This feature can be used to return an instrument to the user settings should it become necessary to load default GSI user key data.

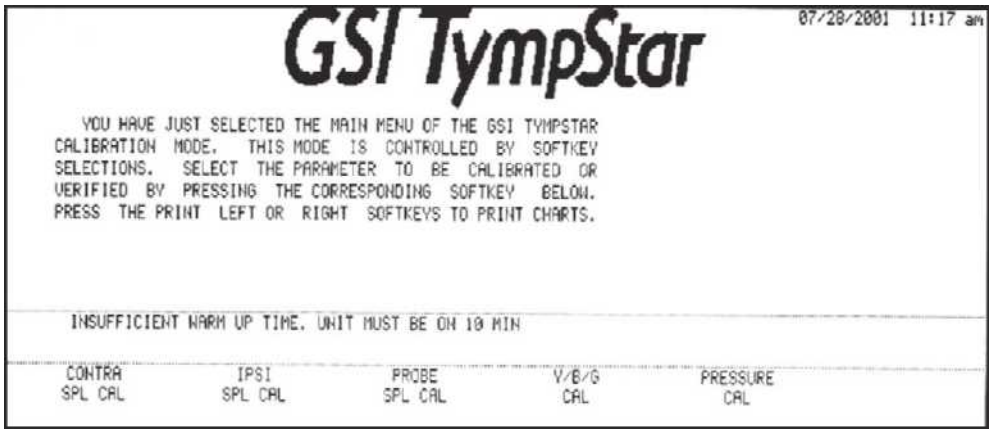
CAUTION
Loading new GSI USER KEY DATA will override any existing customer settings.

Step 4
Load default data if necessary, then press the CONTINUE softkey to perform the Self-Cal.

Upon completion of the Self-Cal, the system will proceed to the Main Calibration Menu screen.

Contra, Ipsi and Probe tone calibration

The calibration test functions are displayed across the bottom of the Main Calibration Menu screen.



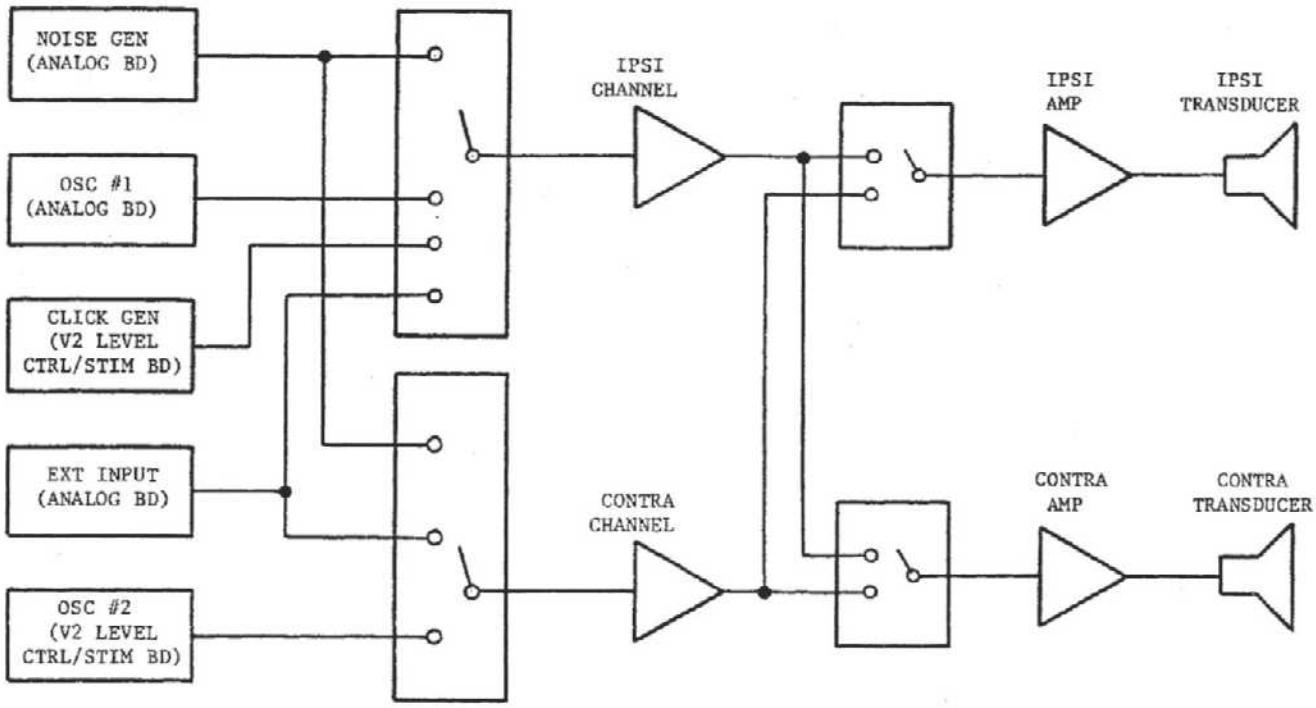
NOTE

The system monitors output levels during these calibrations and alerts the user to levels that invalidate the calibration. These alerts appear when:

- **The stimulus is 5dB outside the acceptable sensitivity range of the transducer.**
- **The stimulus output voltage has reached its limit.**

Contra and Ipsi Cal

The TympStar version 2 provides click output stimuli and an input for user-defined external stimuli. The version 2 also provides more flexible mixing/routing to support Acoustic Reflex Sensitization testing, as shown below.



The flexibility of the version 2 results in a slightly more involved calibration for Ipsi and Contra outputs. The Ipsi transducer must be calibrated on Ipsi and Contra channels. Likewise, the Contra Phone must be calibrated on Contra and Ipsi channels.

External Input Calibration

The voltage requirement for external inputs is 0.5 RVMS to 1.0 RVMS. When set, this stimulus cannot be altered (voltage or frequency) or the outputs will lose their calibration.

The frequency of the external stimulus must be carefully selected for the probe tone with which it will be used. If the stimulus is too close to the probe tone frequency, a stimulus artifact will occur during Reflex tests. Always check for stimulus artifact by presenting the maximum HL in a hardwall cavity and note if there is any Y axis deflection.

The external input will be calibrated with default data when it leaves the factory. The default data will assume that a 1.0 VRMS, 1kHz voltage is applied at the input and that the output is calibrated in SPL (i.e., 80 dB dial reading will provide 80 dB SPL of 1 kHz output).

Click Calibration

GSI recommends that click calibrations be performed with the Sound Level Meter set to the Peak Hold and Linear Mode. This will insure that the repetition rate will have no effect on the measurement.

Clicks will be calibrated in Peak Equivalent SPL at GSI. That is, for a setting of 80 dB HL, the Peak Hold SPL's will be the following:

- IPSI 88.5 dB Peak Hold SPL
- CONTRA 85.5 dB Peak Hold SPL

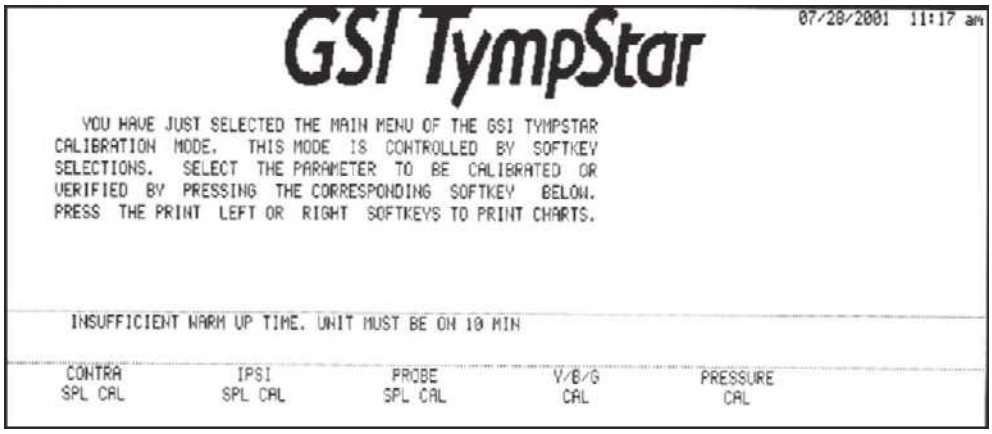
NOTE
Refer to the Click Stimulus section of the Version 2 product specifications for more detailed transfer data.

If Peak Hold is not available on the SLM, use linear (flat) response and fast detector (RMS) and set the click to the following SPL's for the two transducers:

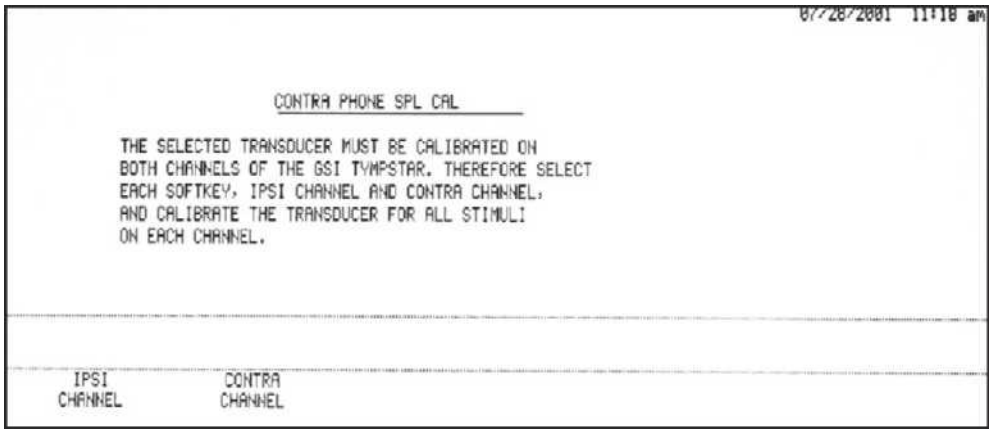
- IPSI at 80 dB HL set to 74.5 dB SPL
- CONTRA at 80 dB HL set to 71.5 dB SPL

Contra SPL Cal

Step 1
Press the CONTRA SPL CAL softkey.

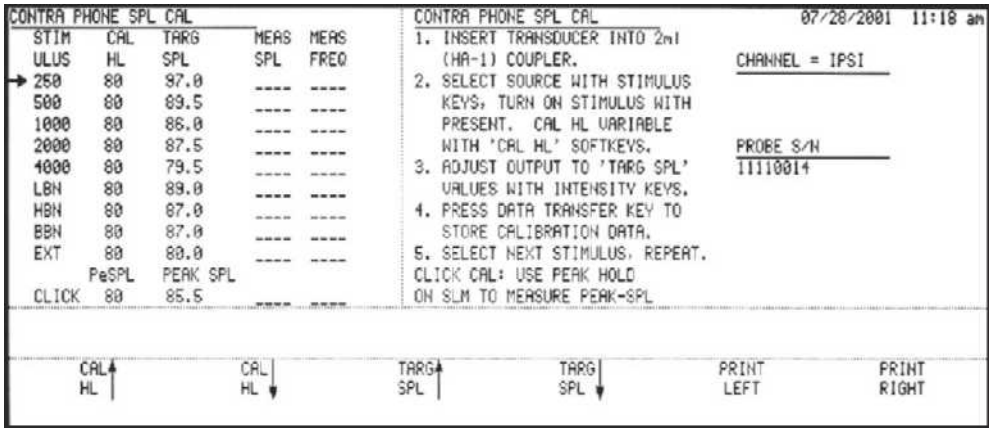


The CONTRA PHONE SPL CAL screen will be displayed.



Ipsi Channel

Step 2
Press the IPSI CHANNEL softkey. The CONTRA PHONE SPL CAL – IPSI CHANNEL screen will be displayed.



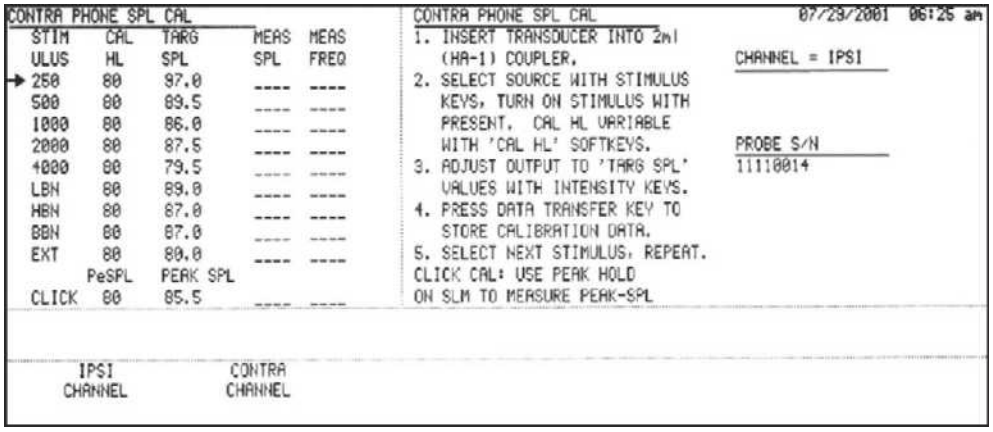
Step 3
Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkeys. The level can be adjusted up or down in 5.0dB increments.

Step 4 (Custom Mode only)
When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL softkeys will be active.

Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

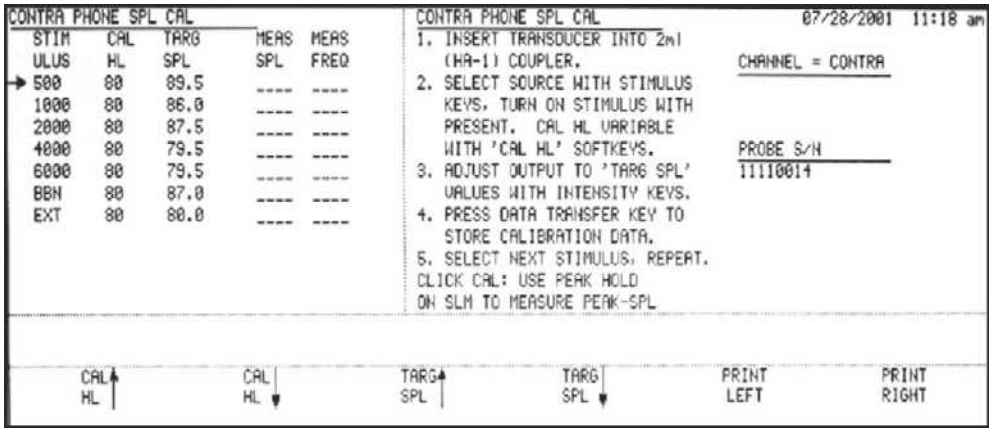
Step 5
Follow the instructions on the screen until all stimulus calibrations are complete.

Step 6
Press the RETURN hardkey to display the IPSI CHANNEL/CONTRA CHANNEL softkeys.



Contra Channel

Step 7
Press the CONTRA CHANNEL softkey. The CONTRA PHONE SPL CAL – CONTRA CHANNEL screen will be displayed.
Step 8



Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkeys. The level can be adjusted up or down in 5.0dB increments.

Step 9 (Custom Mode only)
When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL softkeys will be active.

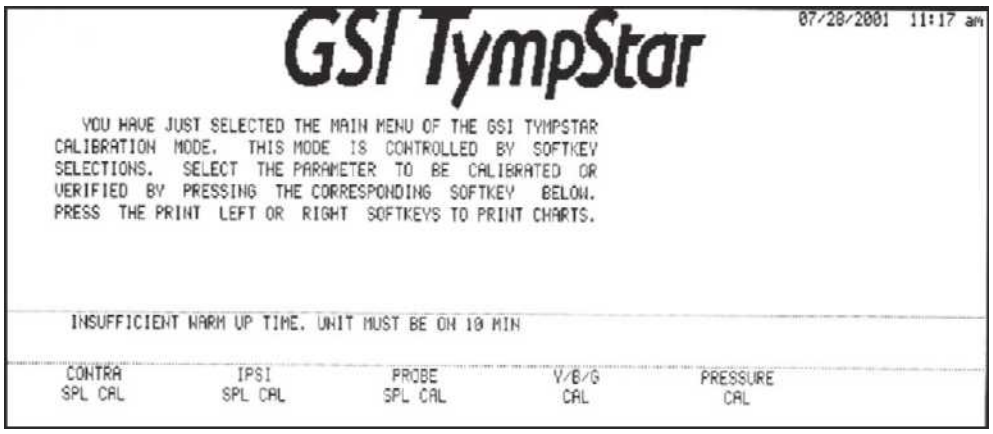
Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

Step 10
Follow the instructions on the screen until all stimulus calibrations are complete.

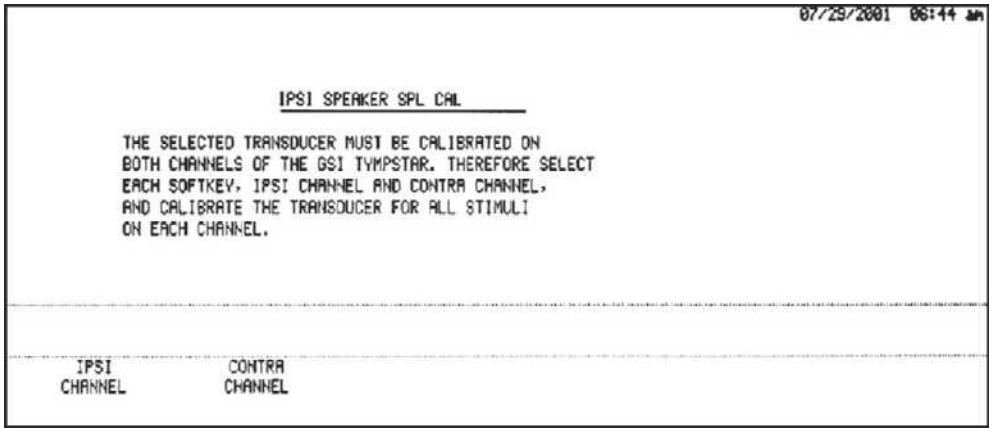
Step 11
Press the RETURN hardkey twice to return to the Main Calibration Menu.

Ipsi SPL Cal

Step 1
Press the IPSI SPL CAL softkey.

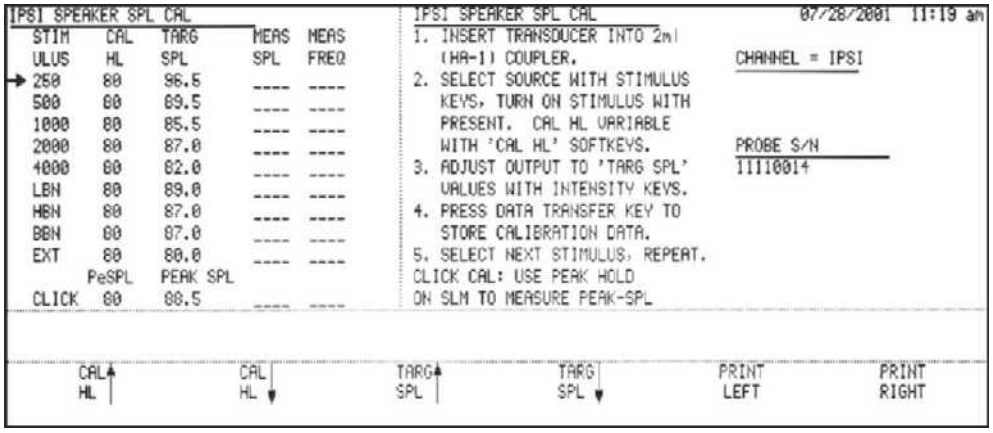


The IPSI SPEAKER SPL CAL will be displayed.



Ipsi Channel

Step 2
Press the IPSI CHANNEL softkey. The IPSI SPEAKER CAL – IPSI CHANNEL screen will be displayed.



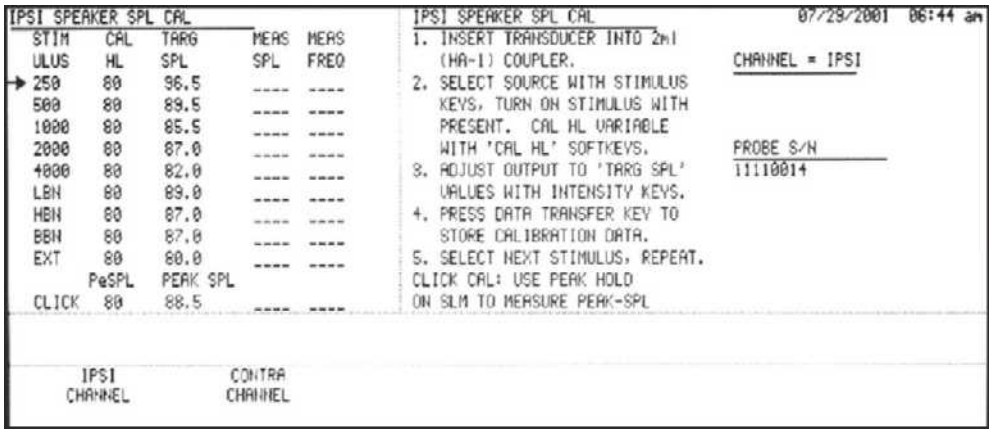
Step 3
Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkeys. The level can be adjusted up or down in 5.0 dB increments.

Step 4 (Custom Mode only)
When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL softkeys will be active.

Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

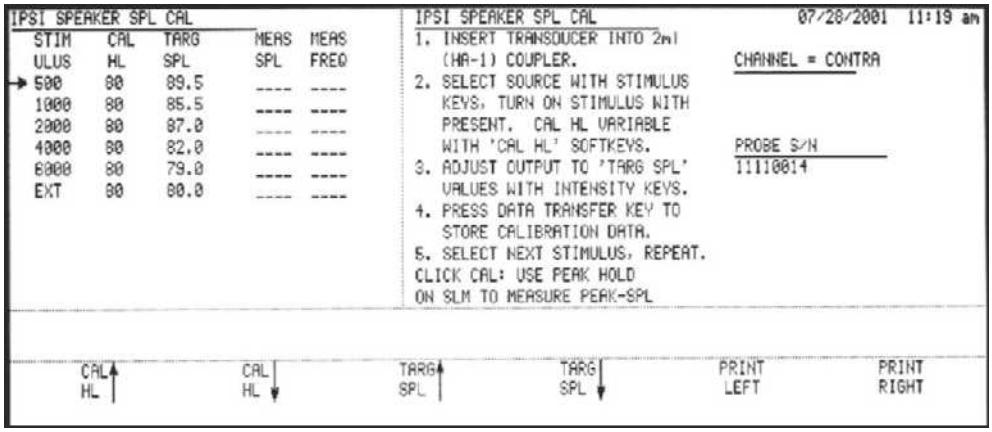
Step 5
Follow the instructions on the screen until all stimulus calibrations are complete.

Step 6
Press the RETURN hardkey to display the IPSI CHANNEL/CONTRA CHANNEL softkeys.



Contra Channel

Step 7
Press the CONTRACHANNEL softkey. The IPSI SPEAKER CAL – CONTRA CHANNEL screen will be displayed.



Step 8
Adjust the overall calibration output level if necessary by pressing the Cal HL up/down softkeys. The level can be adjusted up or down in 5.0dB increments.

Step 9 (Custom Mode only)
When a custom transducer is being calibrated as discussed earlier in Custom Transducers, the TARG SPL softkeys will be active.

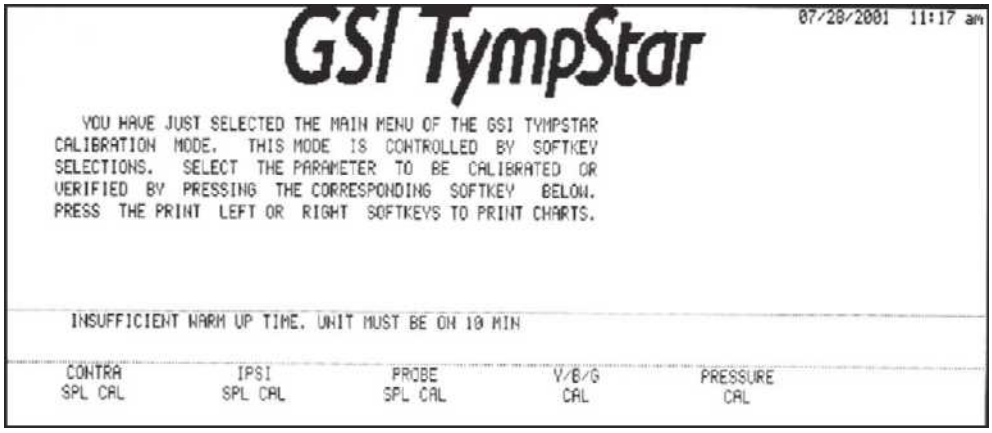
Adjust the target SPL requirement for each frequency by pressing the TARG SPL up/down softkeys. The level can be adjusted up or down in 0.5dB increments. The final values must be within 10dB of the GSI defaults.

Step 10
Follow the instructions on the screen until all stimulus calibrations are complete.

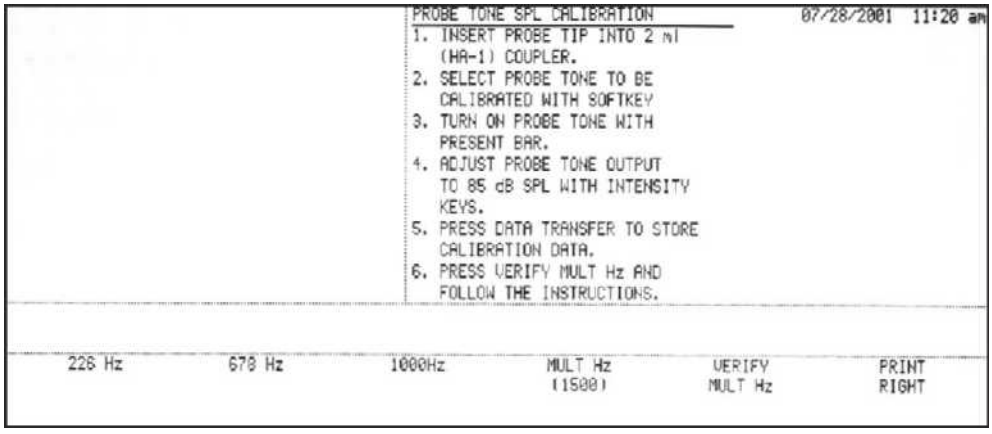
Step 11
Press the RETURN hardkey twice to return to the Main Calibration Menu.

Probe Tone SPL Cal

Step 1
Press the PROBE SPL CAL softkey.

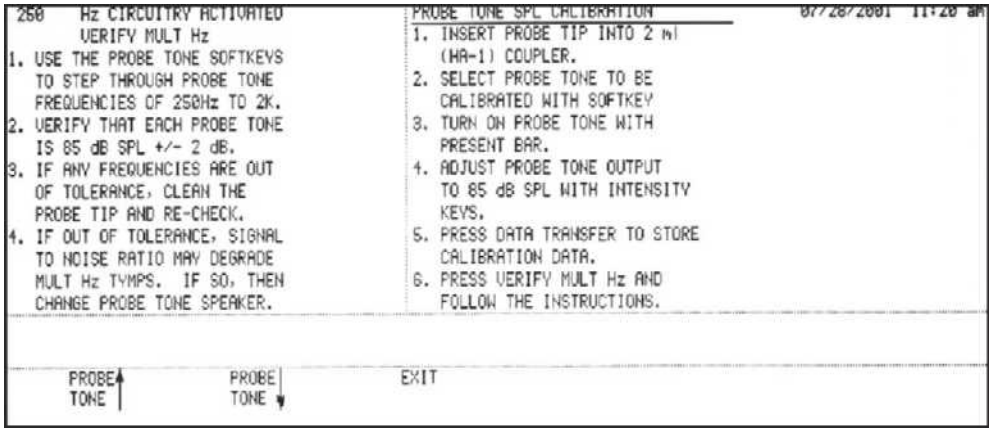


The PROBE TONE SPL CAL screen will be displayed.



Step 2
Follow the instructions on the screen to calibrate probe tone frequencies from 226 Hz through MULT HZ (1500).

Step 3
Press the VERIFY MULT HZ softkey. The VERIFY MULT HZ screen will be displayed.



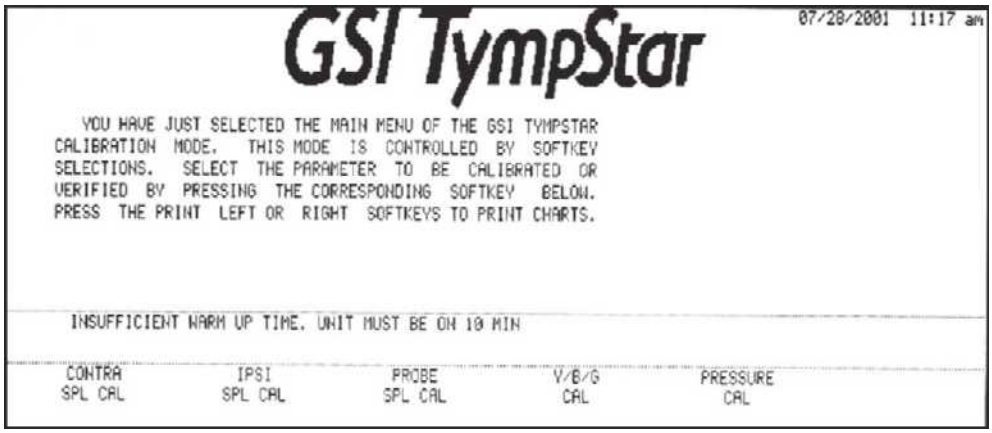
Step 4
Follow the instructions on the screen to verify that all frequencies from 250 Hz to 2kHz are within the acceptable range.

Step 5
Press the EXIT softkey to return to the PROBE TONE SPL CALIBRATION screen.

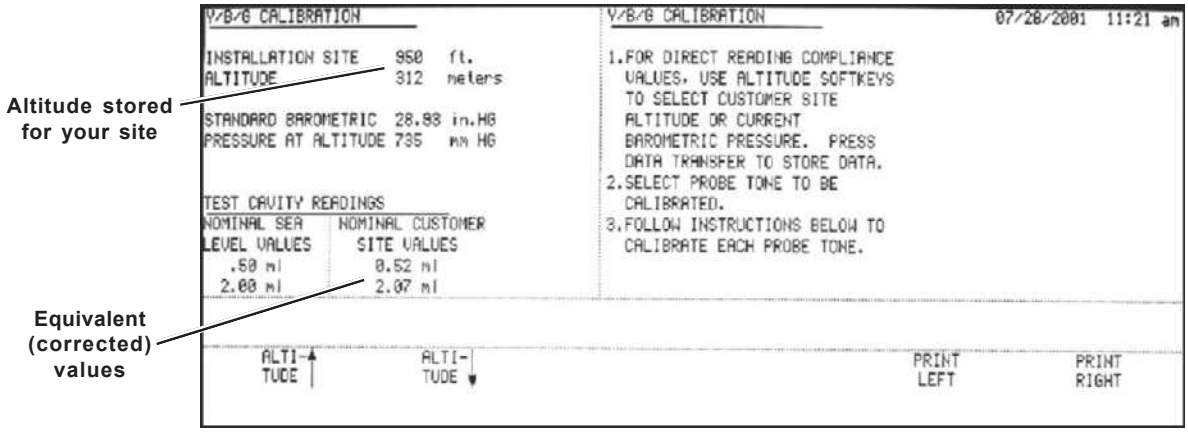
Step 6
Press the RETURN hardkey to return to the Main Calibration Menu.

Y/B/G Cal

Step 1
Press the Y/B/G CAL softkey.



The Y/B/G CALIBRATION screen will be displayed.



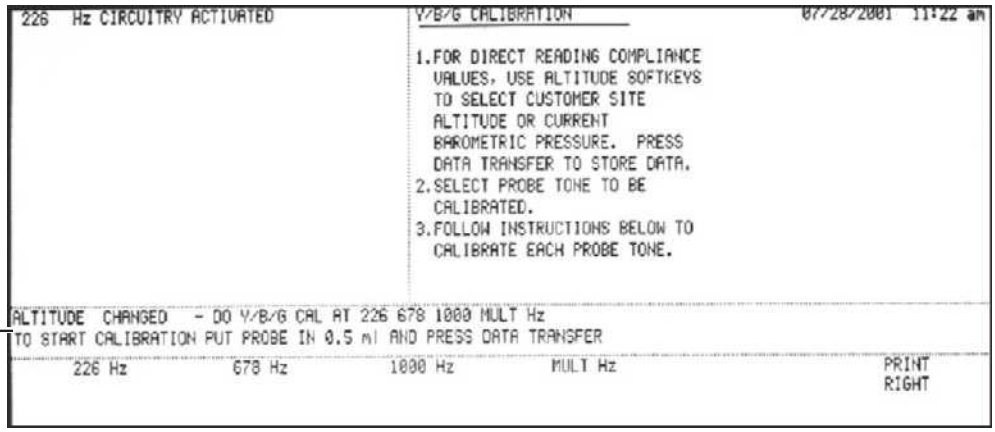
Altitude Cal

Altitude calibration is accomplished as an integral part of the Y/B/G Cal function.

Step 2
Verify that the altitude (elevation) displayed on the screen is correct for your site. If it is not, increase or decrease the value using the ALTITUDE up/down arrows. The altitude can be increased or decreased in 50 foot (16 meter) increments.

NOTE
You will not be allowed to return to the Main Calibration menu without Y/B/G calibration if the altitude was changed.

Step 3
Press the DATATRANSFER hardkey to continue. Additional calibration instruction will be displayed near the bottom of the screen.



Step 4
Follow the instructions on the screen until theY/B/G calibration is complete.

Step 5
Press the RETURN hardkey to return to the Main Calibration screen.

Pressure Cal and diagnostics

The Pressure System calibration and diagnostics of the TympStar Version 1 and Version 2 instruments is identical. Please refer to the pressure system calibration instructions provided earlier in this chapter for the TympStar Version 1.

Returning to Normal Test Mode

When all calibrations have been completed:

- Set all switches of the Cal options DIP switch to OFF (down).
- Set the Cal/Normal switch to Normal.
- Verify that the probe and contra phone are clean and ready for use.
- Close the cover and reinstall the three retaining screws.

Disassembly 5

Introduction

This chapter provides a brief description of the TympStar instrument hardware assemblies, describes component and assembly removal and provides a list of spare parts.

NOTE
Complete procedures are included for disassembly and component removal. Component replacement can be accomplished by reversing the procedures for removal.

NOTE
The TympStar Version 1 hardware is identical to the TympStar Version 2 hardware.

WARNING
Never attempt to remove or install components while power is applied to the TympStar instrument. When power is applied, voltages are present within the enclosure that can cause serious personal injury or death!

WARNING
High voltage might be present in the LCD display enclosure. Never open the LCD enclosure while power is applied to the TympStar instrument.

CAUTION
Repair or bench-testing of the TympStar instrument should be performed only by trained personnel. The following instructions are provided for persons who are skilled in the repair of electronic equipment.

CAUTION
The TympStar instrument is a UL-approved Middle-Ear Analyzer. Consequently, only exact parts replacements should be made during repair. Any alterations of the factory-supplied electrical or mechanical construction or components will void the UL approval.

CAUTION

Many of the components contained within the TympStar instrument are constructed of CMOS and NMOS materials. Failure to observe the following precautions whenever a circuit board or integrated circuit package is handled can result in damage to the instrument.

1) Place the instrument and components on a grounded, conductive work surface.

2) Ground yourself with a wrist-strap having about 1 M Ohm resistance.

3) Ground the frame of any test instrument or soldering iron to be used.

4) Enclose circuit boards in conductive (anti-static) containers for storage or transport.

Disassembly Procedure

Complete procedures are included for disassembly and component removal. Component replacement can be accomplished by reversing the procedures for removal.

CAUTION
Be careful to place any removed hardware, such as screws and washers, in a secure location for reassembly later.

Tools Required

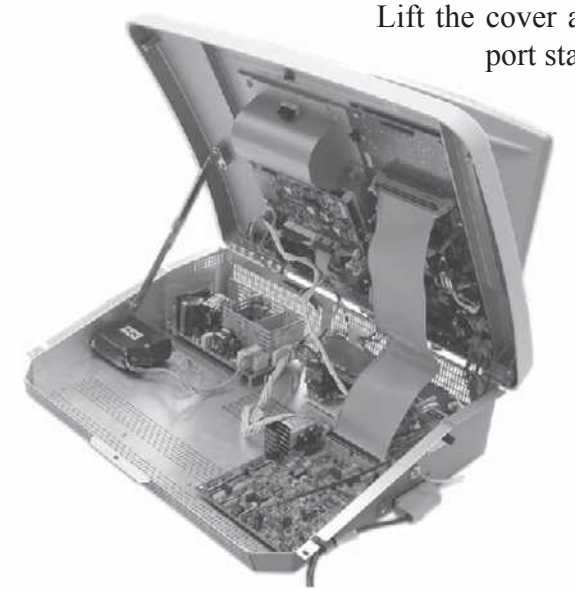
A minimum of standard electronic production tools are required for disassembly and component replacement activities.

- Nut driver set
- Small and medium Philips screwdrivers
- Small and medium straight-edge screwdrivers
- Small and medium wire-cutters
- Small needle-nosed pliers
- Wire ties (4 to 5" in length)

Opening the cover

Step 1
Remove the three retaining screws that secure the cover to the bottom chassis.

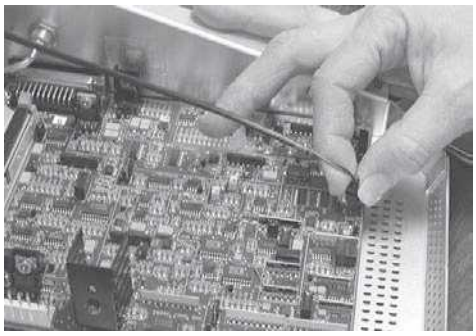
Step 2
Lift the cover and lock the cover support stay in place.



Removing the analog board

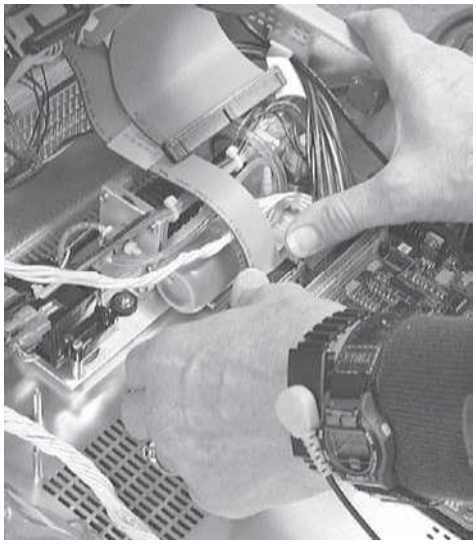
Step 1
Remove the analog power cable by pulling the cable connector straight up.

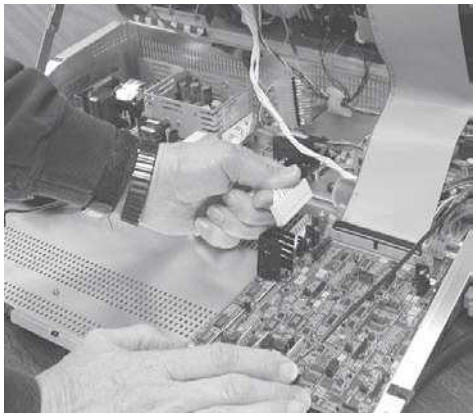
Step 2
Remove the external stimulus cable by pulling the cable connector straight up.



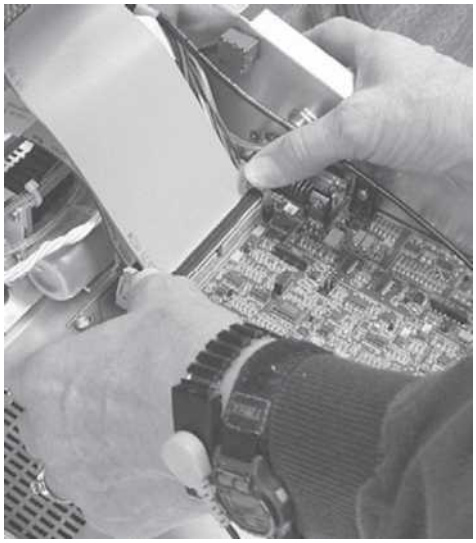
CAUTION
During reassembly, the flat 60-pin digital signal cable must be folded to the rear out over the pump, not to the front over the analog board.

Step 4
Remove the 20-pin digital signal cable by disengaging the two cable connector retainers and pulling the connector straight up.

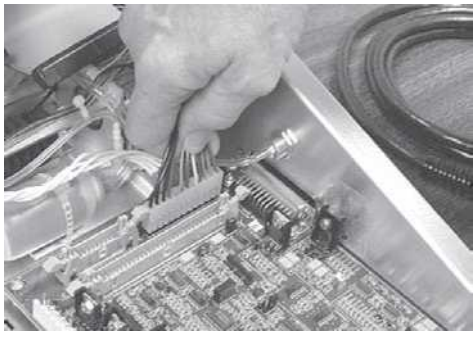




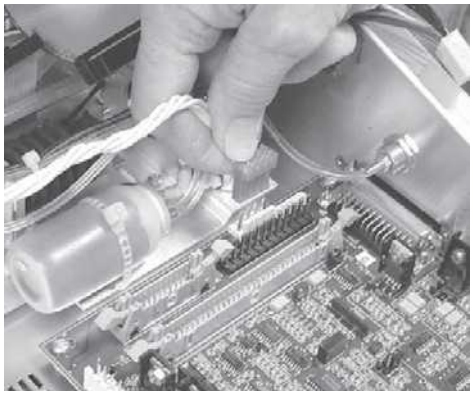
Step 3
Remove the 60-pin digital signal cable by disengaging the two cable connector retainer tabs and pulling the connector straight up.



Step 5
Remove the digital power cable by pulling the cable connector straight up.



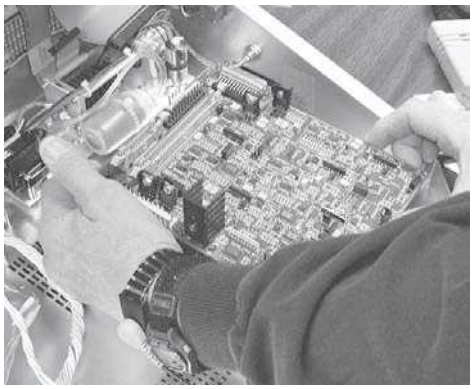
Step 6
Remove the printer power cable by pulling the cable connector straight up.



CAUTION
It is not necessary to disconnect the probe from the analog board to remove the analog board.

Step 7
Remove the four retaining screws at the corners of the board.

Step 8
Remove the analog board by grasping the upper left and lower right corners and pulling the board straight away from the probe connector. Gently rock the board back and forth slightly to disengage the board from the probe connector.



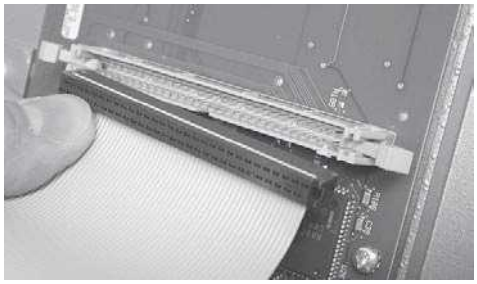
CAUTION
Handle the board carefully by touching only the edges. Do not bend circuit board components.

Removing the Pump

The Tympstar pump is unique to this product. The GSI33 pump assembly should not be used as a replacement.

Step 1

Remove the 60-pin digital signal cable from the digital board mounted under the cover by disengaging the two cable connector retainer tabs and pulling the cable straight out of the connector housing.

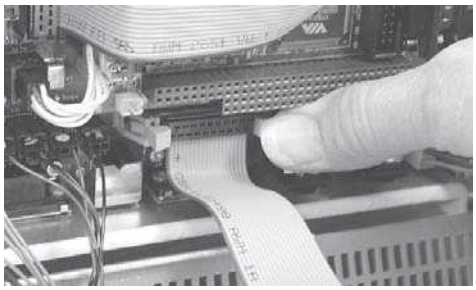


CAUTION

During reassembly, the flat 60-pin digital signal cable must be folded to the rear out over the pump, not to the front over the analog board.

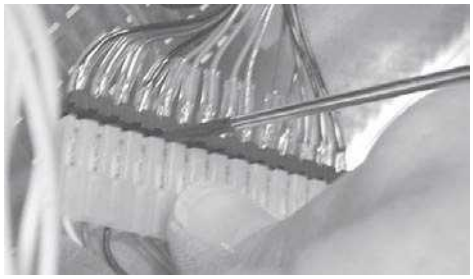
Step 2

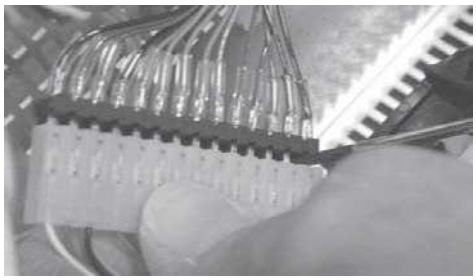
Remove the 20-pin digital signal cable from the rear of the digital board mounted under the cover by disengaging the two cable connector retainer tabs and pulling the cable straight out of the connector housing.



Step 3

Disconnect the pump from the digital board by carefully separating the pump cable connector. Use a flat-edge screwdriver to gradually pry the connector apart.





CAUTION

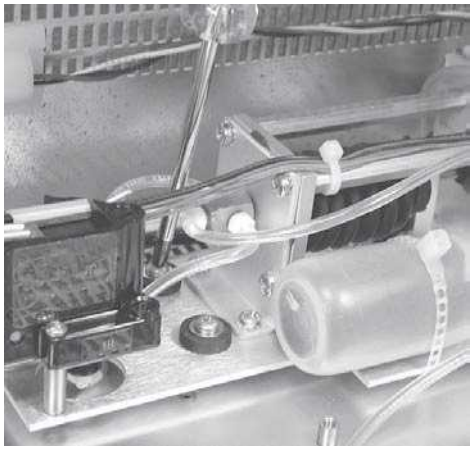
Do not rush this process, or apply excessive force. The cable connector is fragile and will break if bent or stressed.

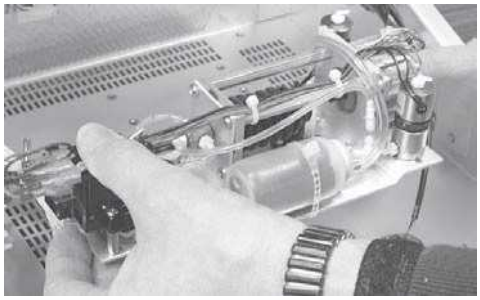
Step 4

Remove the probe pneumatic tube from the holding valve by pulling the tube straight off the valve connection.

Step 5

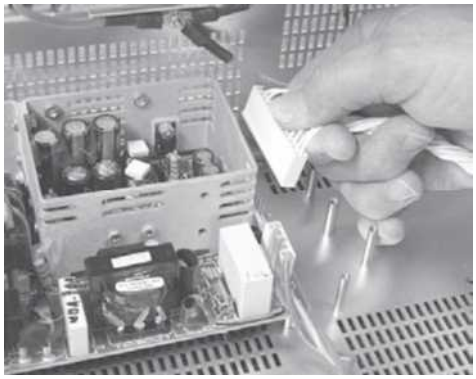
Using a short Philips screwdriver, fully loosen the four retaining screws around the bellows on the bottom of the pump assembly. The pump assembly can now be lifted out of the chassis.





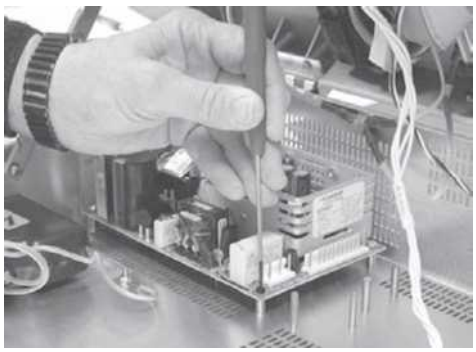
Removing the power supply

Step 1
Disconnect the power output cable by pulling the connector straight up.



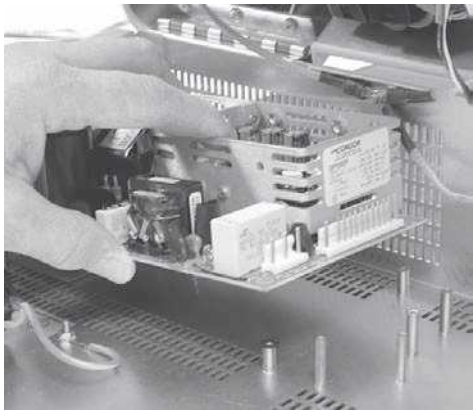
Step 2
Disconnect the power input cable by pulling the connector straight up.

Step 3
Remove the four board retaining screws.



CAUTION
The lower right board retaining screw is a special plastic screw and must be replaced in this position along with the plastic washer under the board during reassembly.

Step 4
Lift the power supply out of the chassis.

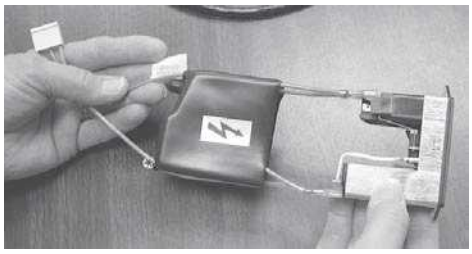


Removing the power module

Step 1
Disconnect the grounding lug connection.

Step 2
Pull the protective rubber boot away from the side panel and remove the two retaining nuts using a 1/4" open-end wrench.

Step 3
Remove the power module from the chassis.

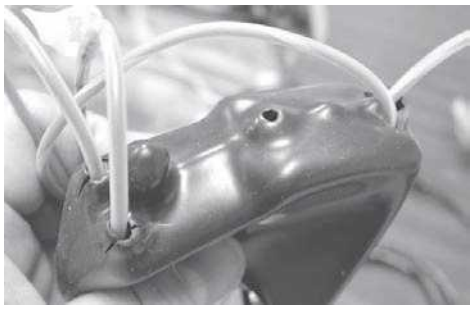


Fuse holder

The fuse holder can be removed using a flat-edge screwdriver.

NOTE

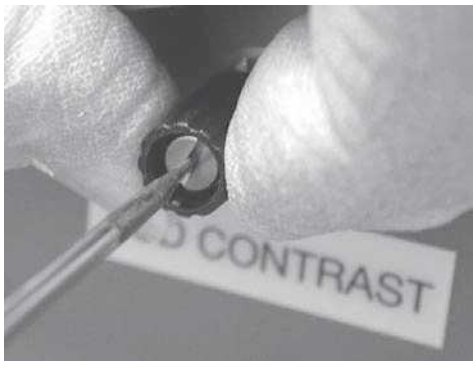
NOTE
Holes may need to be cut in replacement protective rubber boots to accommodate wiring harnesses.



Removing the LCD contrast control

Step 1
Remove the contrast control knob-cap.

Step 2
Loosen the contrast control knob retaining screw while holding the knob.

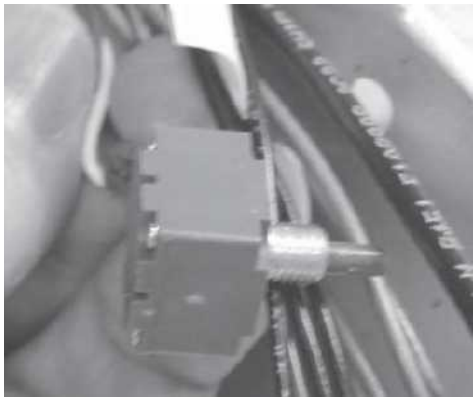


NOTE

NOTE
It is unnecessary to completely remove the screw.

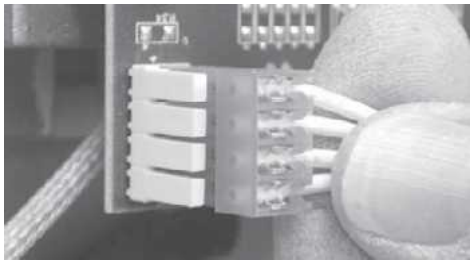
Step 3
Remove the knob.

Step 4
Using a nut-driver, remove the LCD contrast control potentiometer's retaining nut and pull the potentiometer out of the chassis.

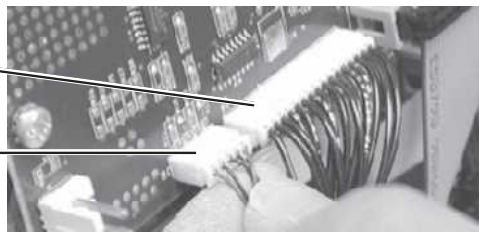


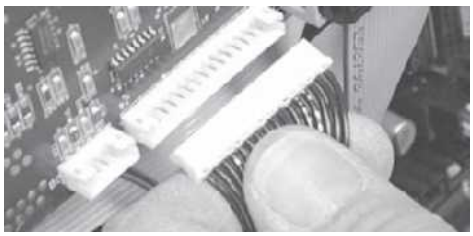
Removing the printer board

Step 1
Disconnect the printer power cable from the printer board by pulling the cable connector straight off the housing.

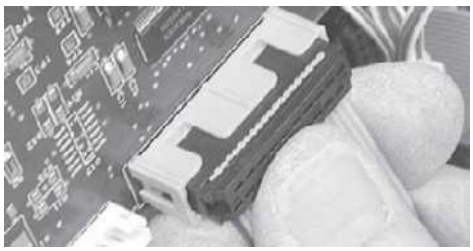


Step 2
Disconnect the two printer signal cables by pulling the cable connectors straight off the housings.



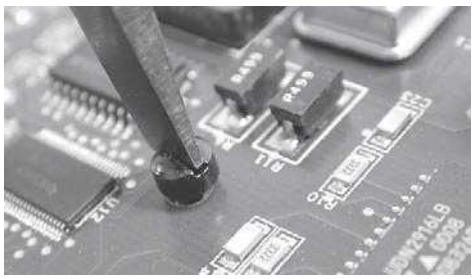


Step 3
Disconnect the 20-pin digital signal cable by pulling the cable connector straight out of the housing.



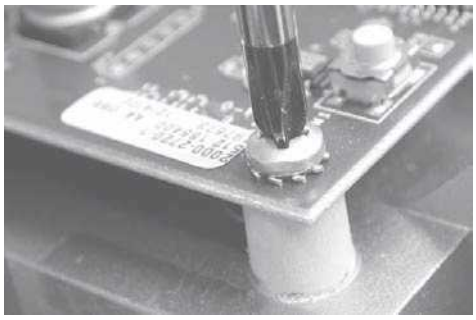
Step 4
Disconnect the printer motor connector by pulling it straight away from the board.

Step 5
Remove the plastic screw from the printer board.



CAUTION
The plastic screw must be replaced in this position during reassembly.

Step 6
Remove the three metal screws from two upper and lower left corner of the board.

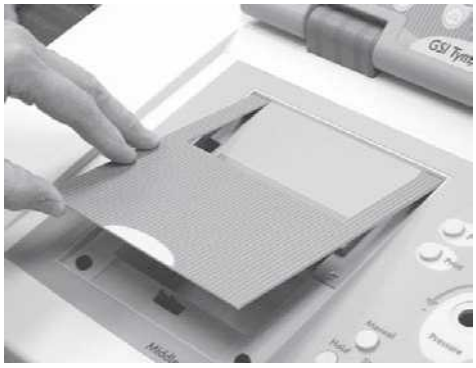


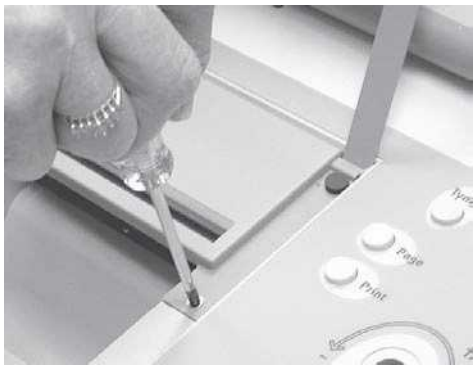
Step 7
Remove the printer board from the chassis.

Removing the printer

Step 1
Remove the printer board as described earlier. Rotate the LCD up and back away from the front panel.

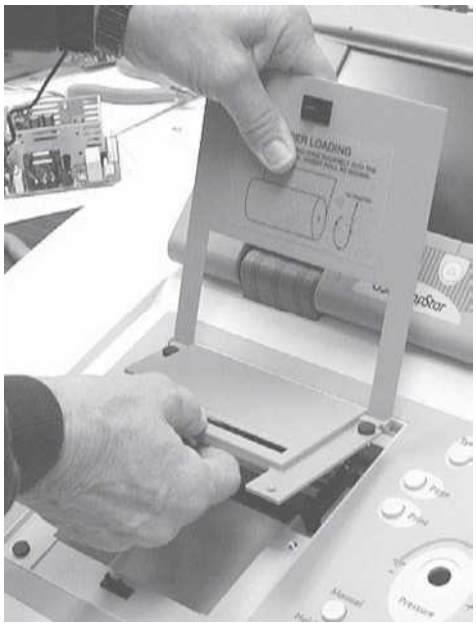
Step 2
Open the printer door.





Step 3
Remove the two screws (left and right) that secure the printer doorframe to the cover.

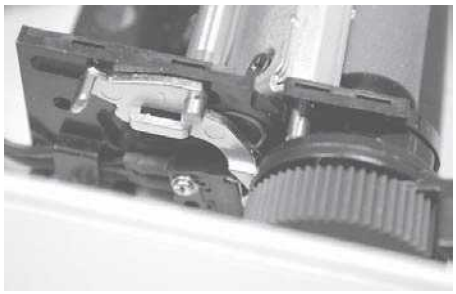
Step 4
Remove the printer doorframe by holding the top and bottom together as the assembly is lifted up and toward the front of the instrument. The two pieces of the assembly can easily be separated at the hinge by gently bending the top piece.



Step 5
Cut the two cable ties inside the unit- under the printer on the left and right sides of the printer.

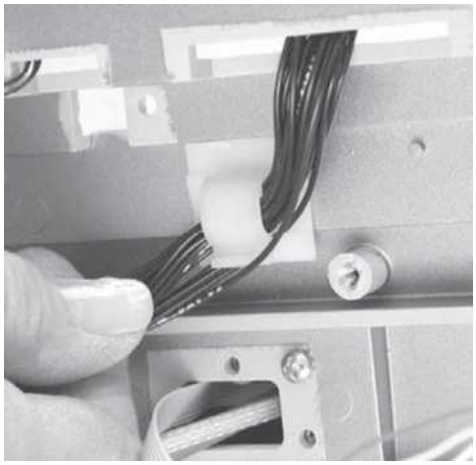
Step 6
Disconnect the screw that secures the ground strap to the top of the printer.

The paper bar must first be moved aside to provide access to the screw. Hold the roll release lever in its top position while pressing down on the bar release, then move the paper bar to expose the screw.

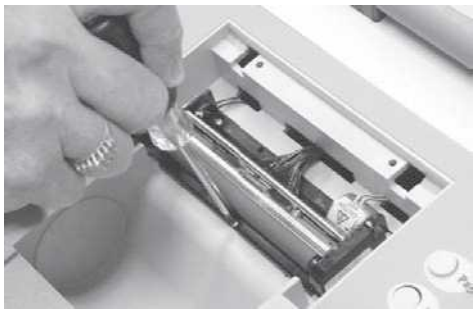


CAUTION
The ground strap screw is metric and might be difficult to replace in your geographic location. Store the screw with care.

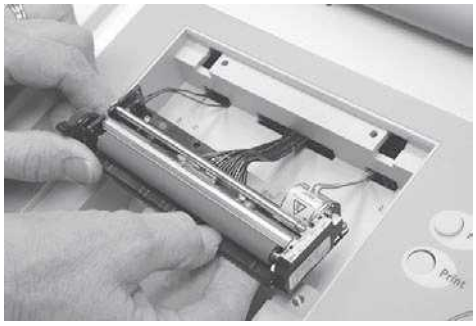
Step 7
Remove the bundle of black printer cable wires from the cable clamp under the top cover.



Step 8
Remove the printer retainer screws at the front and rear of the printer assembly.



Step 9
Carefully remove the printer assembly from the top cover, while guiding the printer cables through the slots in the cover.



Step 10
Disconnect the data cable from the printer assembly by grasping the wire bundle firmly and pulling the cable straight off the printer connector.

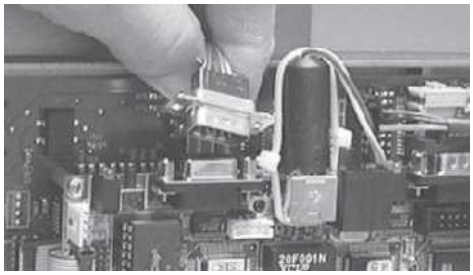
Removing the PC104 Board

Step 1
Place the TympStar on its side and disconnect the support bar to open the case wider.

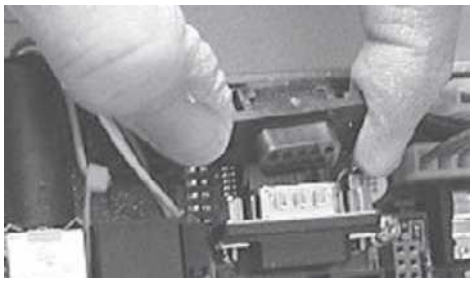
Step 2
Disconnect the 60-pin digital signal cable from the digital board to gain access to the PC104 board.

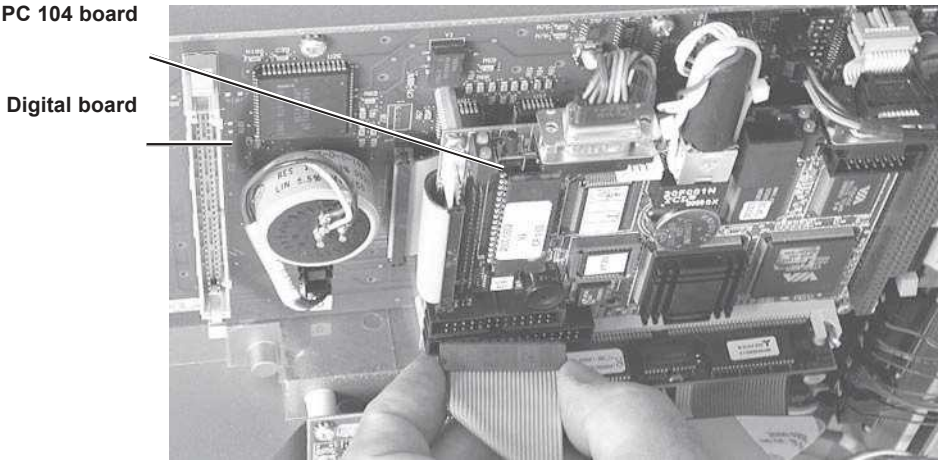
Step 3
Disconnect the male 15-pin D-connector from the PC104 board by pulling the connector straight up.

Step 4
Disconnect the female 15-pin D-connector from the PC104 board by pulling the connector straight up.

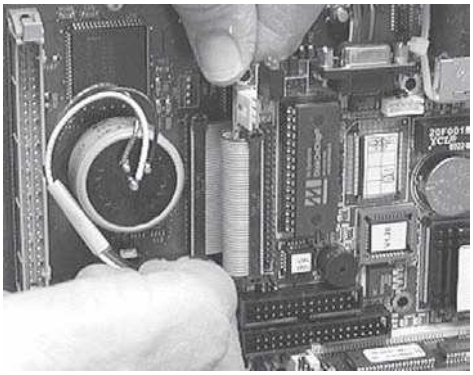


Step 5
Disconnect the 26-pin LCD board cable from the PC104 board by pulling the connector straight up.

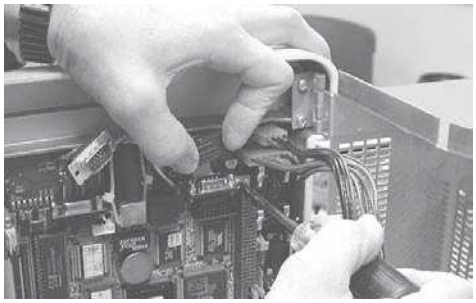




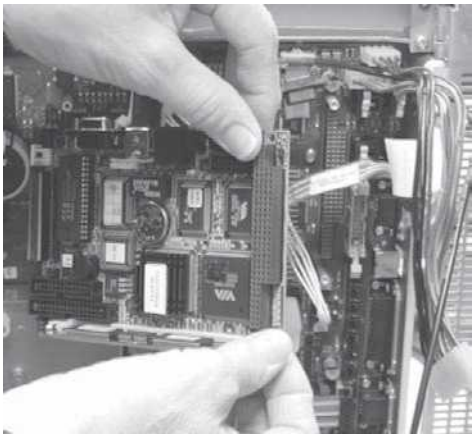
Step 6
Disconnect the digital board cable from the PC104 board by pulling the connector straight up.



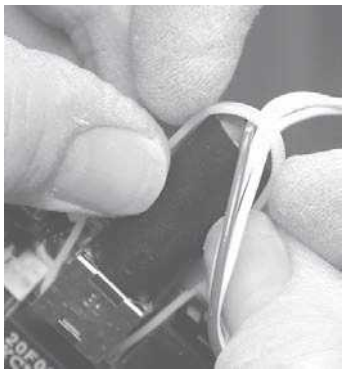
Step 7
Remove the four retaining screws at the corners of the PC104 board.

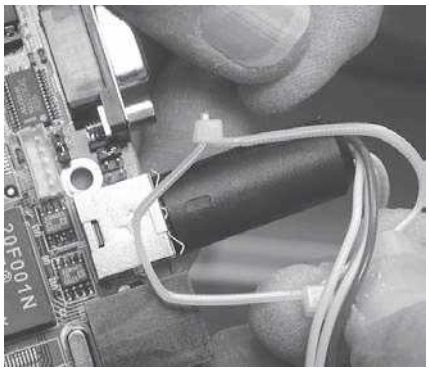


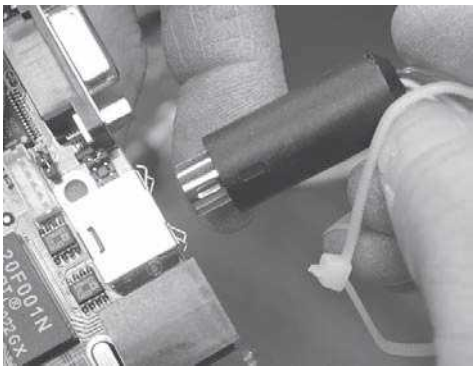
Step 8
Remove the PC104 board by pulling the connector on the end of the board straight away from the digital board. Gently rock the connector slightly back and forth to ease the connector out of the digital board.



Step 9
Remove the 5-wire cable from the PC104 board by slipping the tie-wrap over the cylindrical board connector and pulling the connector straight away from the board.



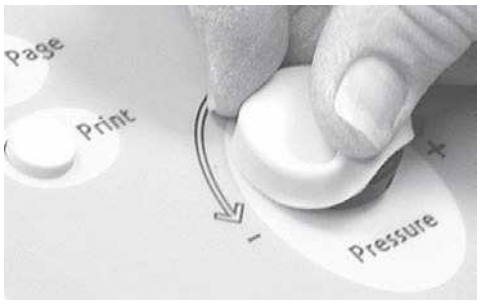


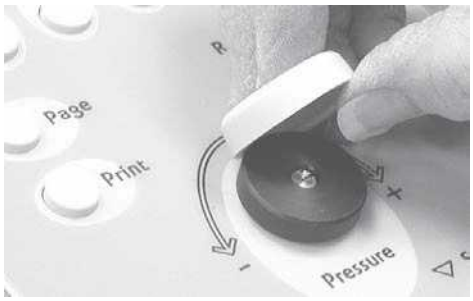


Removing the digital board

Step 1
Remove the PC104 board using the procedure provided earlier in this chapter.

Step 2
Remove the rubber pressure adjustment knob cover by rubbing the knob cover at the edge of the knob.

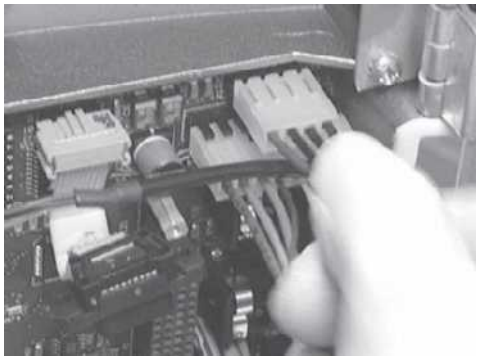


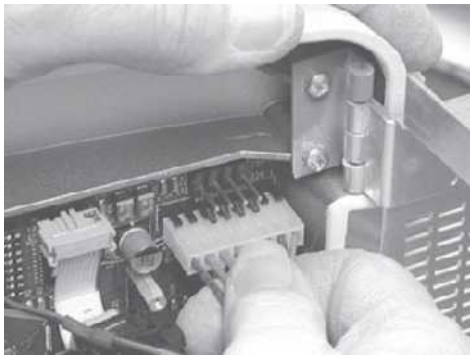


Step 3
Remove the pressure adjustment knob using a 1/16" allen wrench. Loosen the two setscrews and lift the knob off the panel.

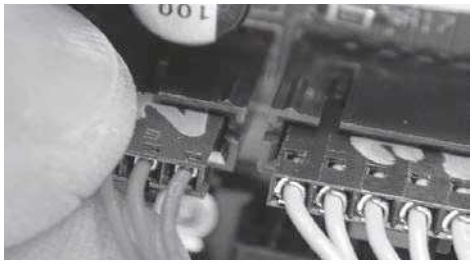
CAUTION
Verify that there is clearance between the bottom of the knob and the panel surface when reinstalling and tightening the knob to avoid scratching the panel.

Step 4
Disconnect the 4-wire and 8-wire analog board cables.



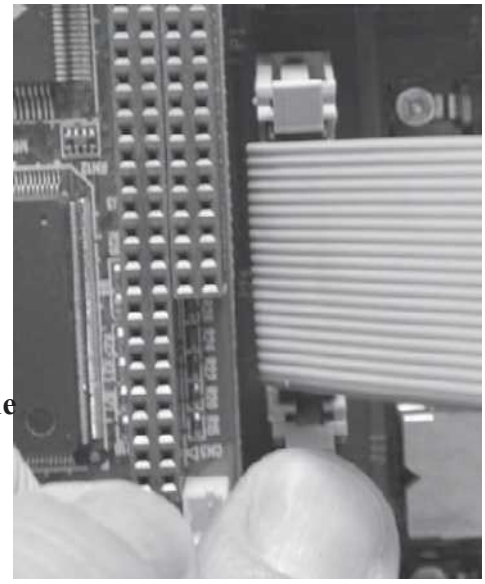


Step 5
Disconnect the six pump assembly cables by disengaging each locked connector and pulling the connectors straight away from the board.



Step 6
Disconnect the analog board external stimulus cable by disengaging the locked connector and pulling the connector straight away from the board.

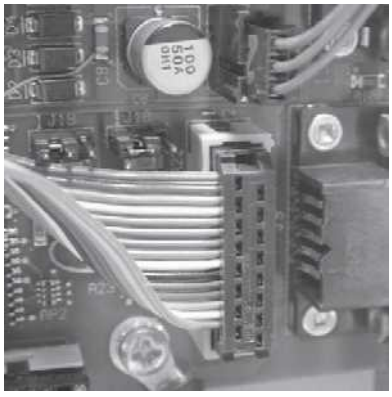
Step 7
Disconnect the analog board 20-pin signal cable by disengaging the two cable connector tabs and pulling the connector straight away from the board.

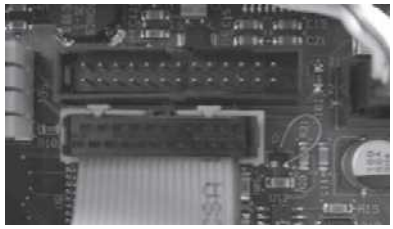


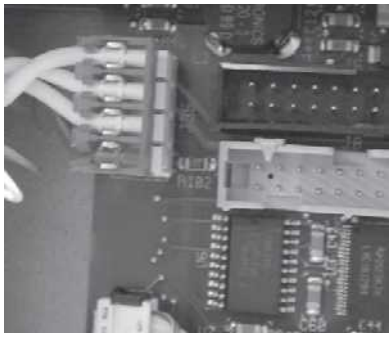
NOTE

NOTE
GSI recommends that all digital board cables connected to the PC 104 board remain temporarily connected to facilitate proper cable placement and orientation when installing a new digital board.

Step 8
Disconnect the remaining LCD and printer ribbon cables by pulling the connectors straight away from the board.

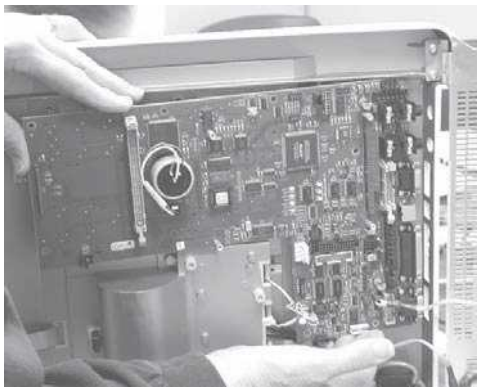


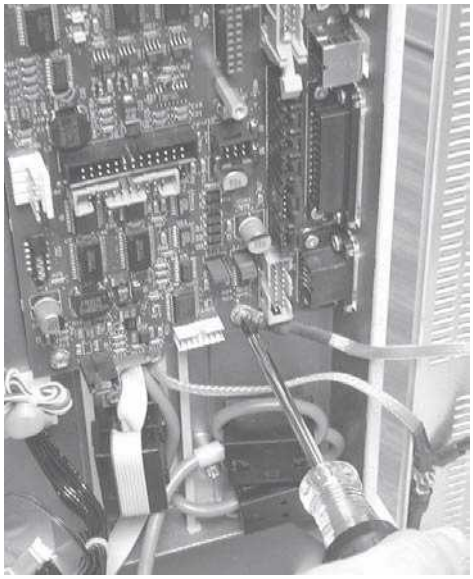




Step 9
Disconnect the ground strap by removing the Philips retaining screw.

Step 10
Remove the remaining eight retaining screws and gently move the board away from the connector holes in the back of the cover.

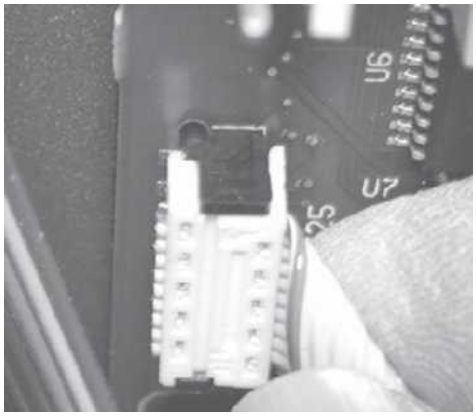




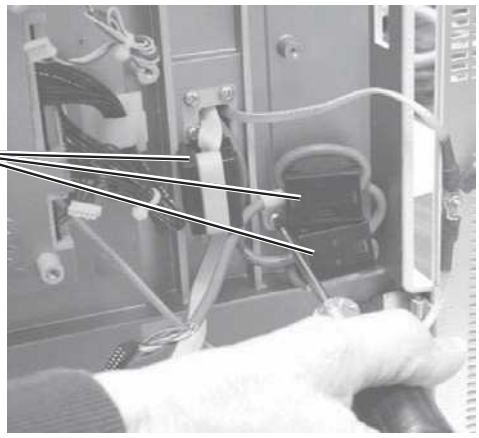
When the connectors on the board have cleared the holes, lift the board straight out of the cover.

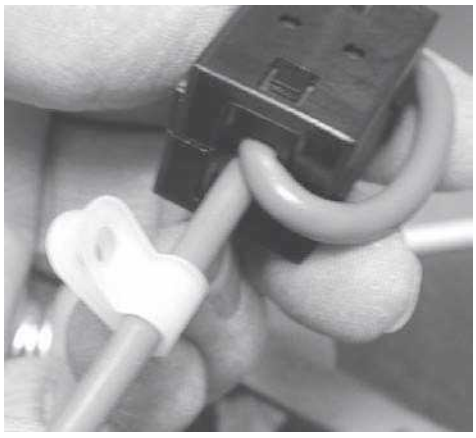
Removing the LCD or Softkeypad cables

Step 1
Disconnect the LCD cable from the digital board.

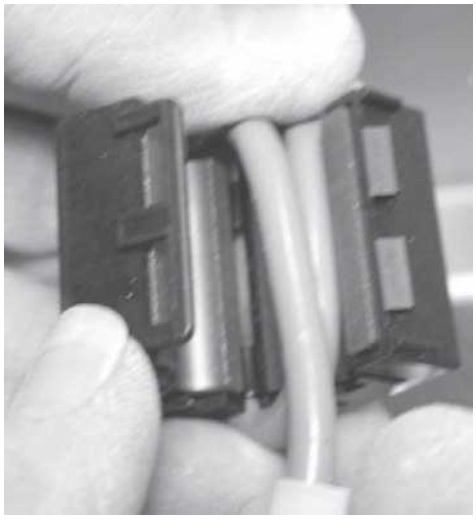


Step 2
Remove the surge-suppressor cable clamp retaining screw, and remove the cable clamp.





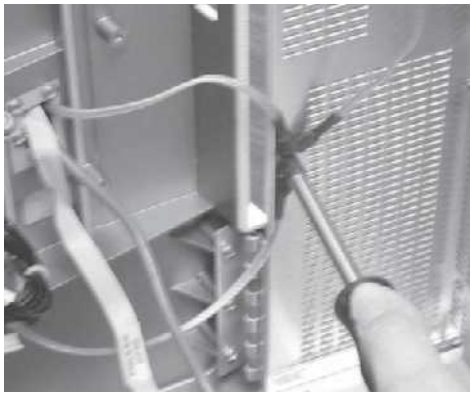
Step 3
Unclamp and remove the three surge suppressors.



Step 4
Cut and remove the plastic cable tie that secures the LCD cables to the cover.

Removing the LCD or Softkeypad cables (continued)

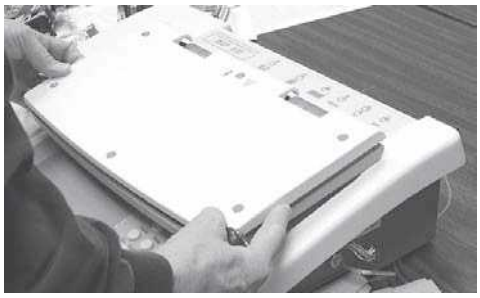
Step 5
Remove the nut that secures the grounding straps to the rear chassis.

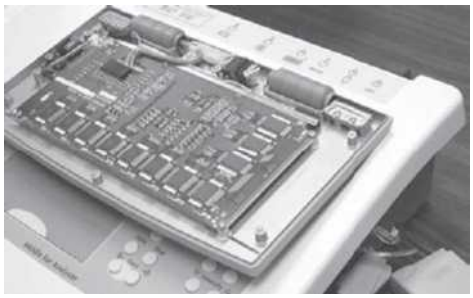


Step 6
Place the TympStar in its normal orientation and rotate the LCD forward to expose the screw holes in the back of the LCD enclosure.

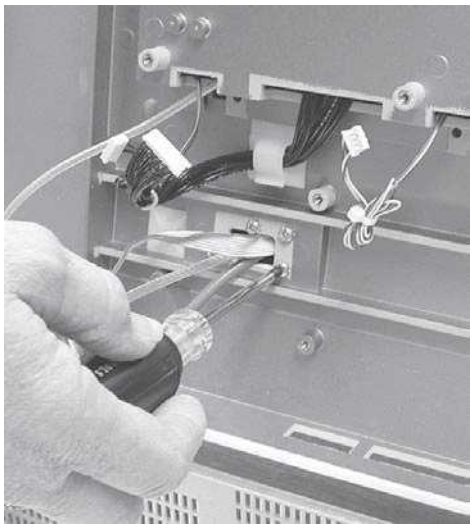
Step 7
Remove the six screws that secure the back cover to the LCD enclosure.

Step 8
Gently lift the LCD back cover straight off the LCD enclosure.



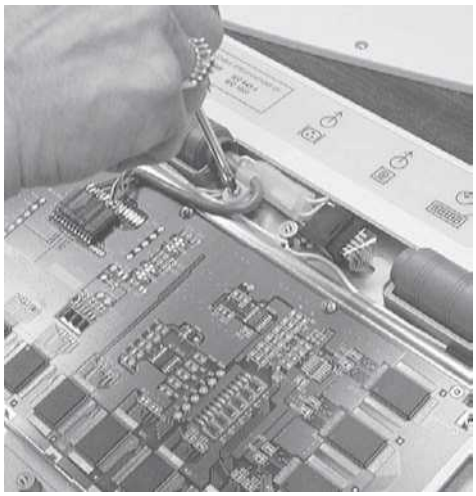


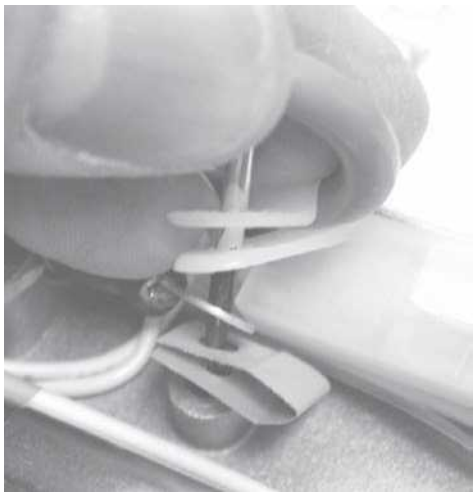
Step 9
Remove the four screws located under the top panel that secure the left LCD panel hinge.



Removing the LCD or Softkeypad cables (continued)

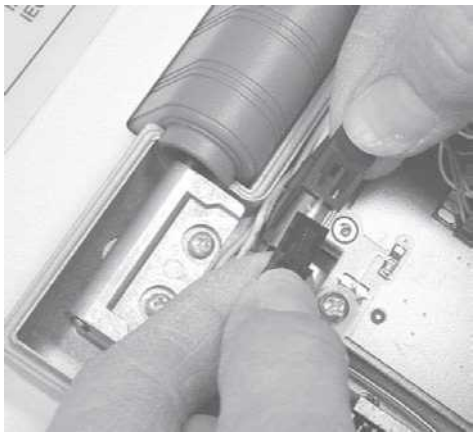
Step 10
Remove the screw located under the LCD enclosure that secures the cable clamp to the top-left of the chassis. The cable clamp rests on top of a ground cable connector and folded metal conductor.



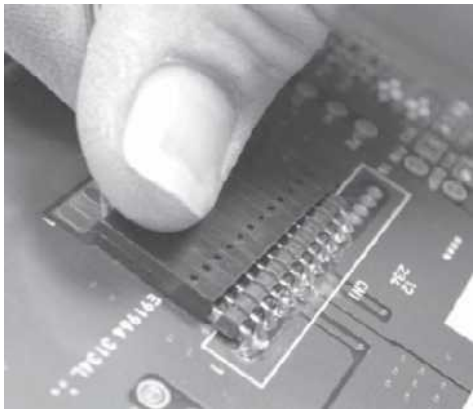


CAUTION
The cable clamp and two conductors must be re-assembled in exactly the same orientation.

Step 11
Disconnect the inverter assembly cable.



Step 12
Disconnect the 12-pin cable connector from the LCD assembly by grasping the connector firmly and gently pulling it straight off the pins. Gently rock the connector back and forth as it is pulled off the pins.

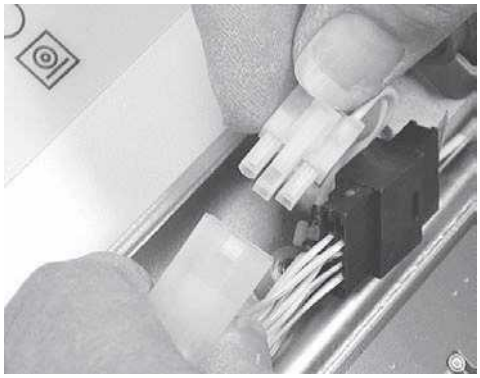


CAUTION
The brown cable wire should be connected to pin 1 on the board when the cable is re-installed.

Removing the LCD or Softkeypad cables (continued)

Step 13
Remove the two left hinge screws.

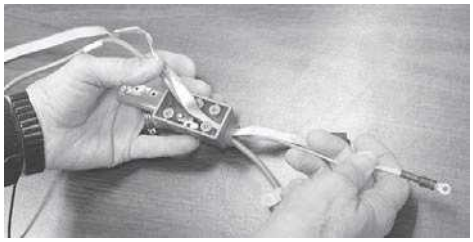
Step 14
Unplug the 3-pin white plastic cable connector.



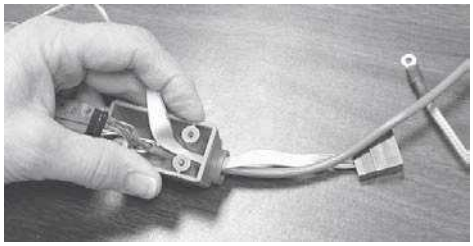
Step 15
Unplug the black plastic cable connector.

Step 16
Remove the left hinge cover, LCD cable, ground cable and keypad cable by carefully pulling the three cables through the hinge block chassis hole.

Step 17
Remove the braided ground strap.

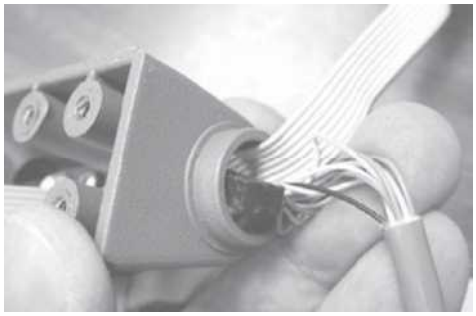


Step 18
Remove the shielded display cable.

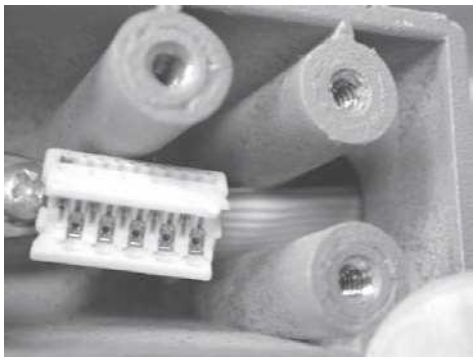


Removing the LCD or Softkeypad cables (continued)

Step 19
Move the flat cable against the outside of the cable opening, and using needle-nose pliers, carefully orient the black cable header sideways in the cable opening. Gently pull the LCD cable header through the hole.



Step 20
Orient the flat Softkeypad cable header sideways and pull the header through the hole, while gently pushing the cable header through the hole with a screwdriver.

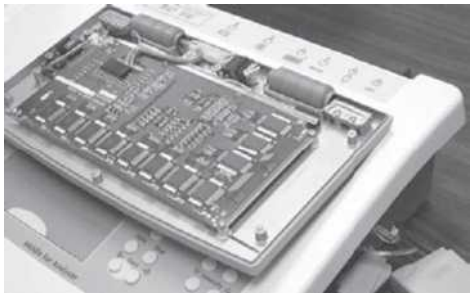


Removing the LCD

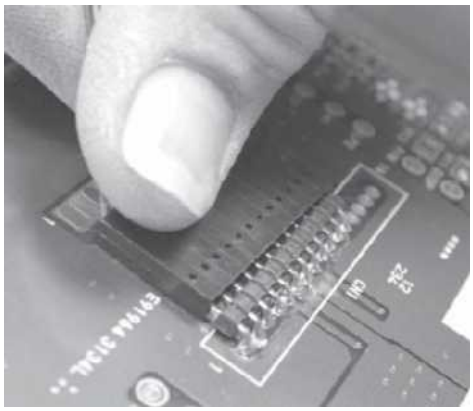
Step 1
Place the TympStar in its normal orientation and rotate the LCD forward to expose the screw holes in the back of the LCD enclosure.

Step 2
Remove the six screws that secure the back cover to the LCD enclosure.

Step 3
Gently lift the LCD back cover straight off the LCD enclosure.

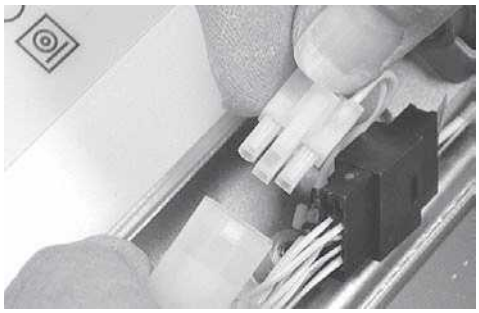


Step 4
Disconnect the 12-pin cable connector from the LCD assembly by grasping the connector firmly and gently pulling it straight off the pins. Gently rock the connector back and forth as it is pulled off the pins.

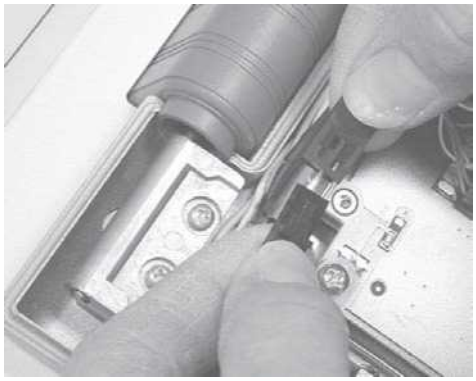


CAUTION
The brown cable wire should be connected to pin 1 on the board when the cable is re-installed.

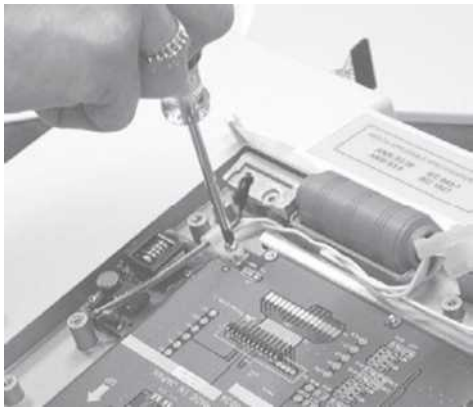
Step 5
Unplug the white cable connector near the hinge assembly.



Step 6
Unplug the black inverter cable connector.



Step 7
Remove the four screws that retain the LCD circuit board to the cover, and carefully remove the LCD board/ screen assembly.



The LCD is attached to the rear of the board.

CAUTION
Do not touch the surface of the LCD. Clean the surface if necessary using clean compressed air.

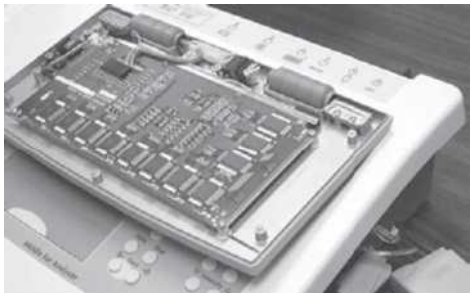
CAUTION
The screen surfaces of replacement LCD assemblies are protected by blue plastic. Remove the protective plastic carefully and do not touch the LCD screen surface.

Removing the LCD front panel label (softkey panel)

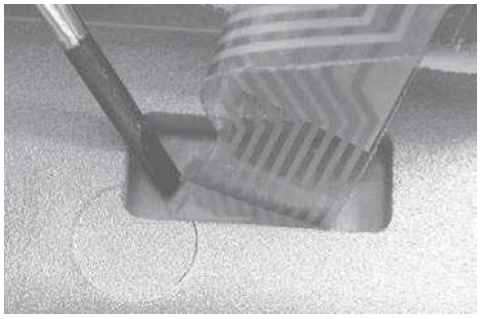
Step 1
Place the TympStar in its normal orientation and rotate the LCD forward to expose the screw holes in the back of the LCD enclosure.

Step 2
Remove the six screws that secure the back cover to the LCD enclosure.

Step 3
Gently lift the LCD back cover straight off the LCD enclosure. Disconnect the black Softkey cable connector.



Step 4
Fold, but do not crease, the keypad flex circuit cable and apply a gently pressure to the back of the LCD panel label through the cable slot in the front LCD enclosure panel. The right lower corner of the label will lift off the surface of the panel.

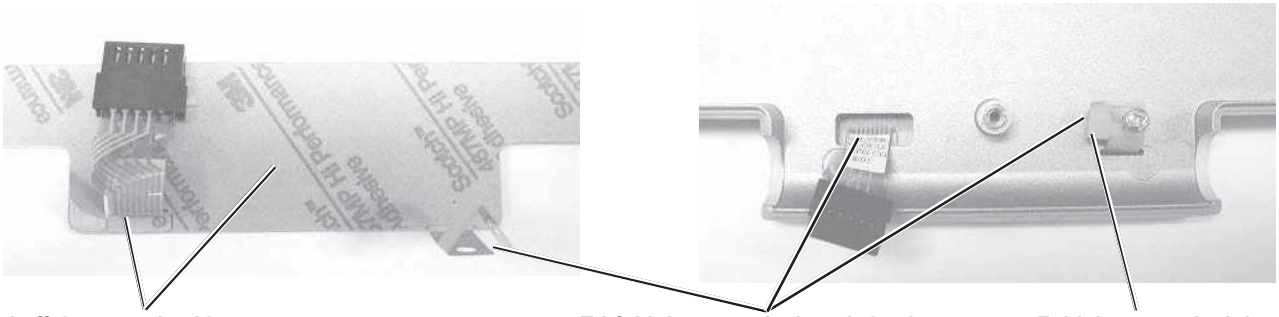


Step 5
From inside the LCD case, remove the screw that secures the cable clamp and grounds in the left-top of the chassis. Fold the flat keyboard ground connection sheet and slide it through the slot in the left lower corner of the LCD enclosure panel while peeling the label off the panel.

CAUTION!

CAUTION
Do not fold or bend the label.

Step 6
When installing a new Softkey panel, peel off the paper backing to expose the adhesive surface, including the small piece of paper beneath the flex cable. Tri-fold the ground tab and stick the label to the LCD front panel while simultaneously inserting the flex cable connector and ground tab through their respective slots.



Peel off the paper backing to expose the adhesive surface, including the small piece of paper beneath the flex cable, and apply to the front of the LCD panel.

Tri-fold the ground tab and simultaneously insert the flex cable connector and ground tab through their respective slots in the panel.

Fold the ground tab in half and make sure the dull (not shiny) side is in contact with the post.

Removing the instrument front panel label

Step 1
Carefully insert the tip of a pointed blade under a corner of the label and lift the corner away from the front panel.

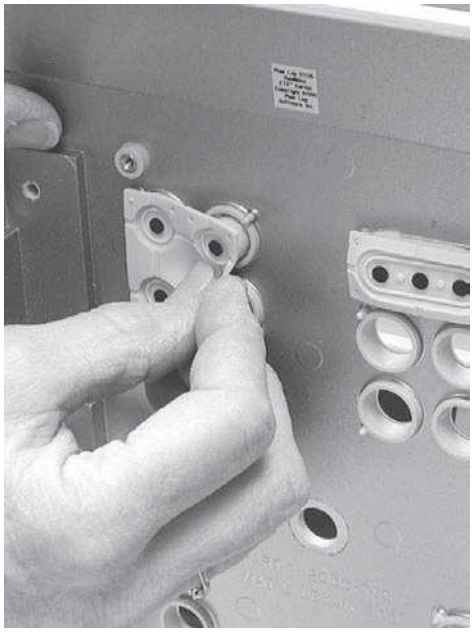
Step 2
Gently peel the label off the front panel.

CAUTION
Do not fold or bend the label.

Removing panel keypads

Step 1
Remove the PC104 and digital boards as described earlier in this chapter.

Step 2
Gently pull the rubber keypad contacts out of the holes in the front panel.



CAUTION
During reassembly, be careful to secure the corner of each keypad module by pushing the panel locator pin fully through the hole in the corner of the module.

NOTE
One-key and two-key modules are cut from four-key modules.

System Level 6

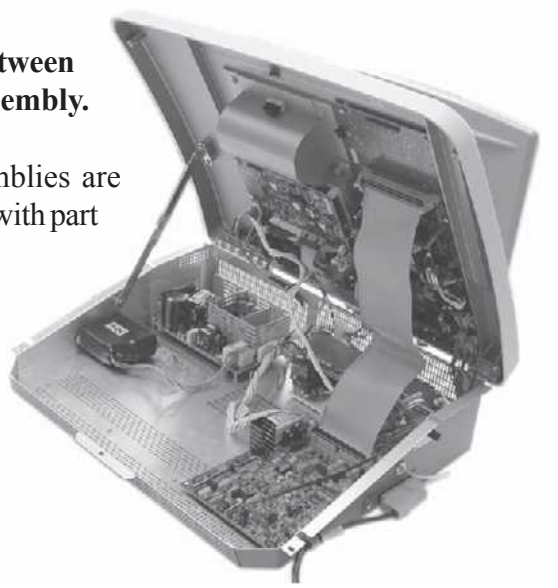
General

This chapter describes the system level components and assemblies included in the TympStar Version 1 and Version 2 instruments.

NOTE

NOTE
The only hardware difference between the two versions is the probe assembly.

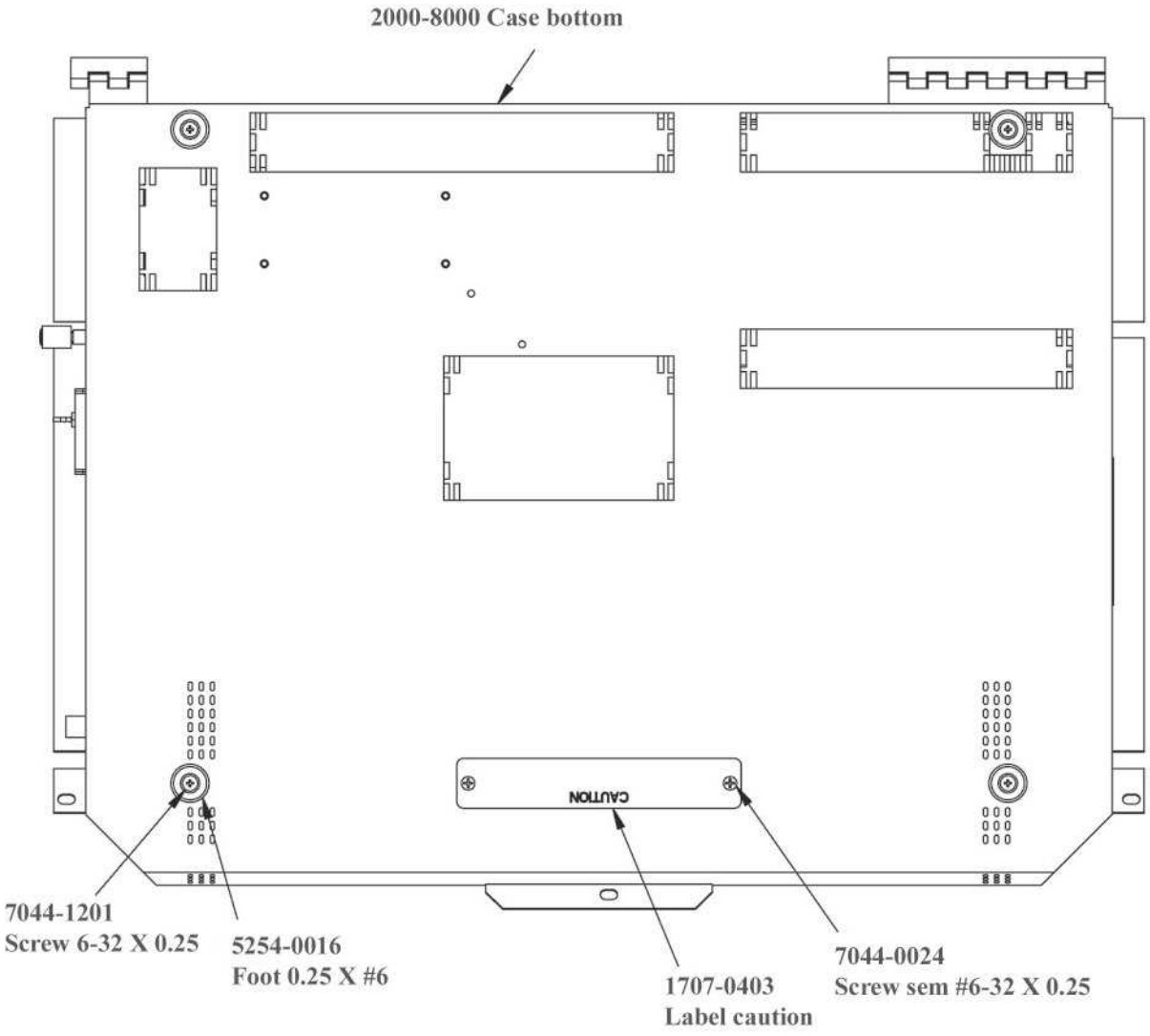
Hardware components and assemblies are shown graphically using drawings with part and assembly number designations.

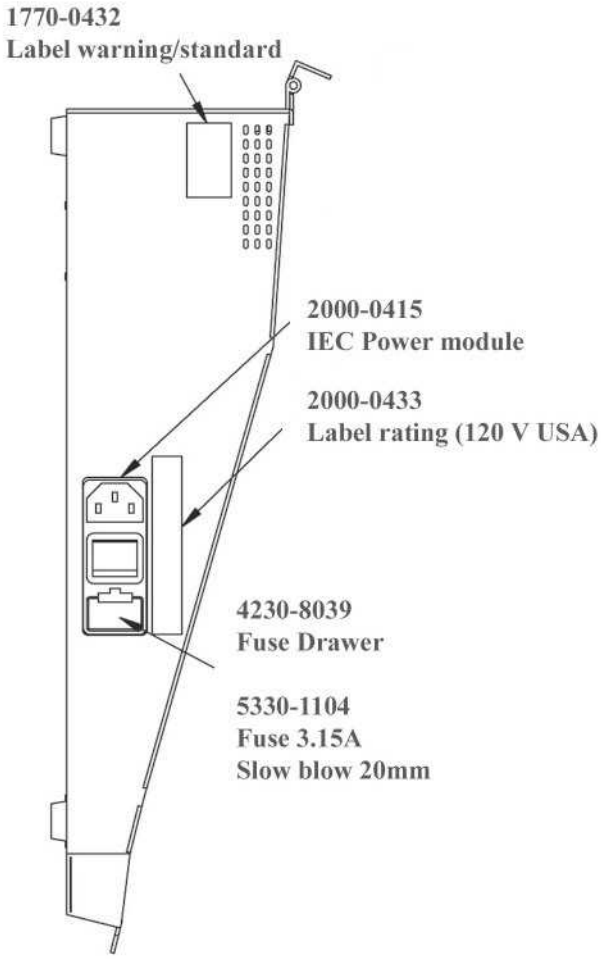


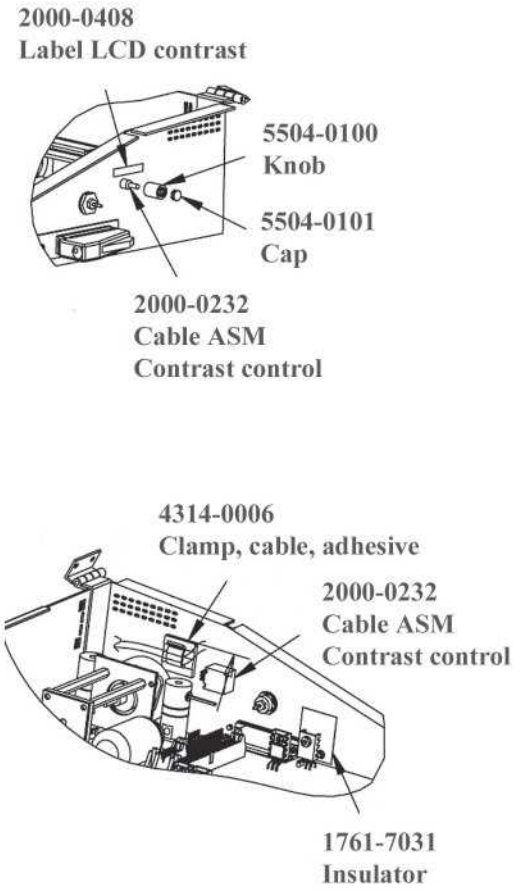
Assembly drawings

The following assembly drawings are included:

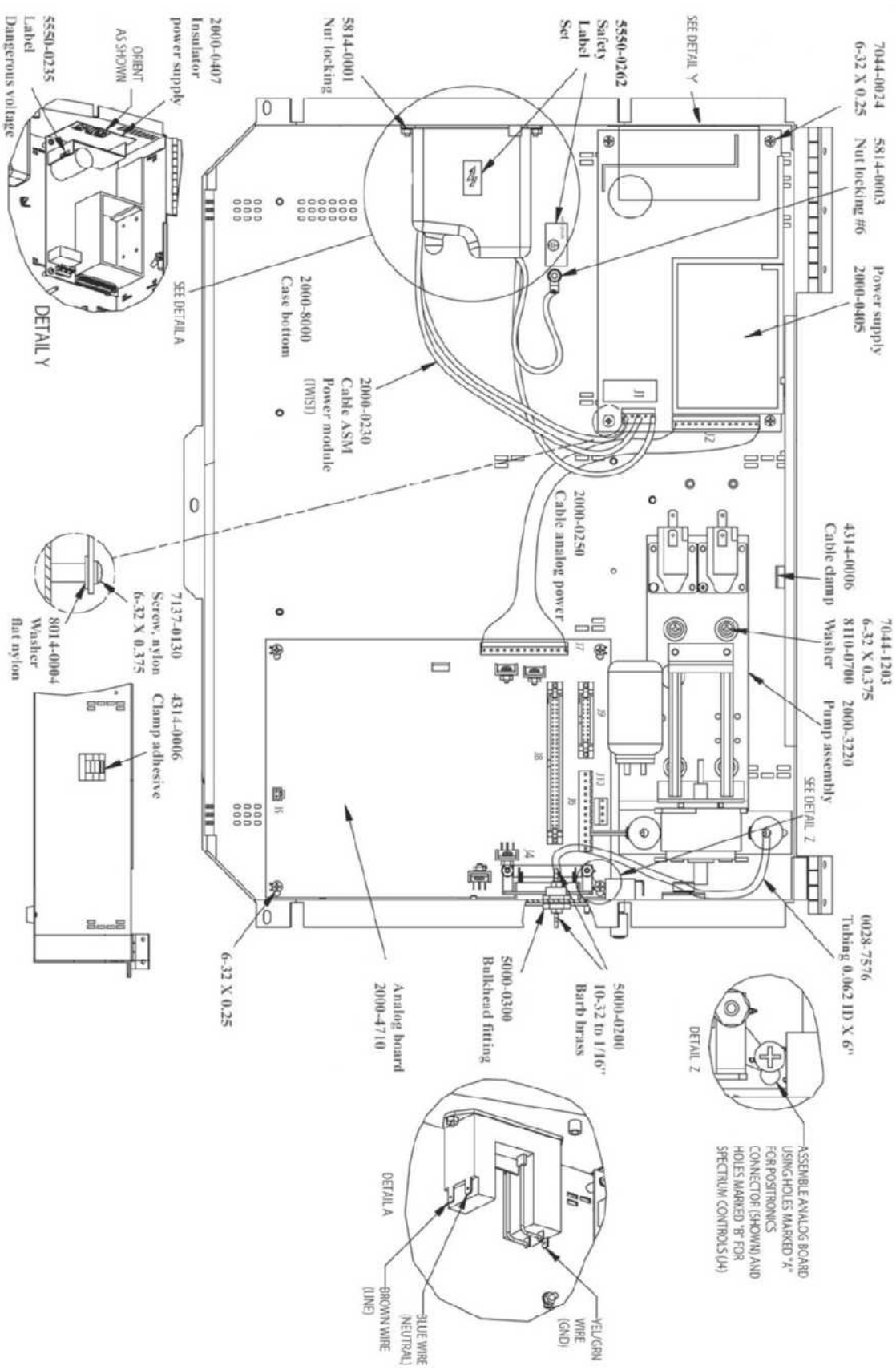
Case/chassis



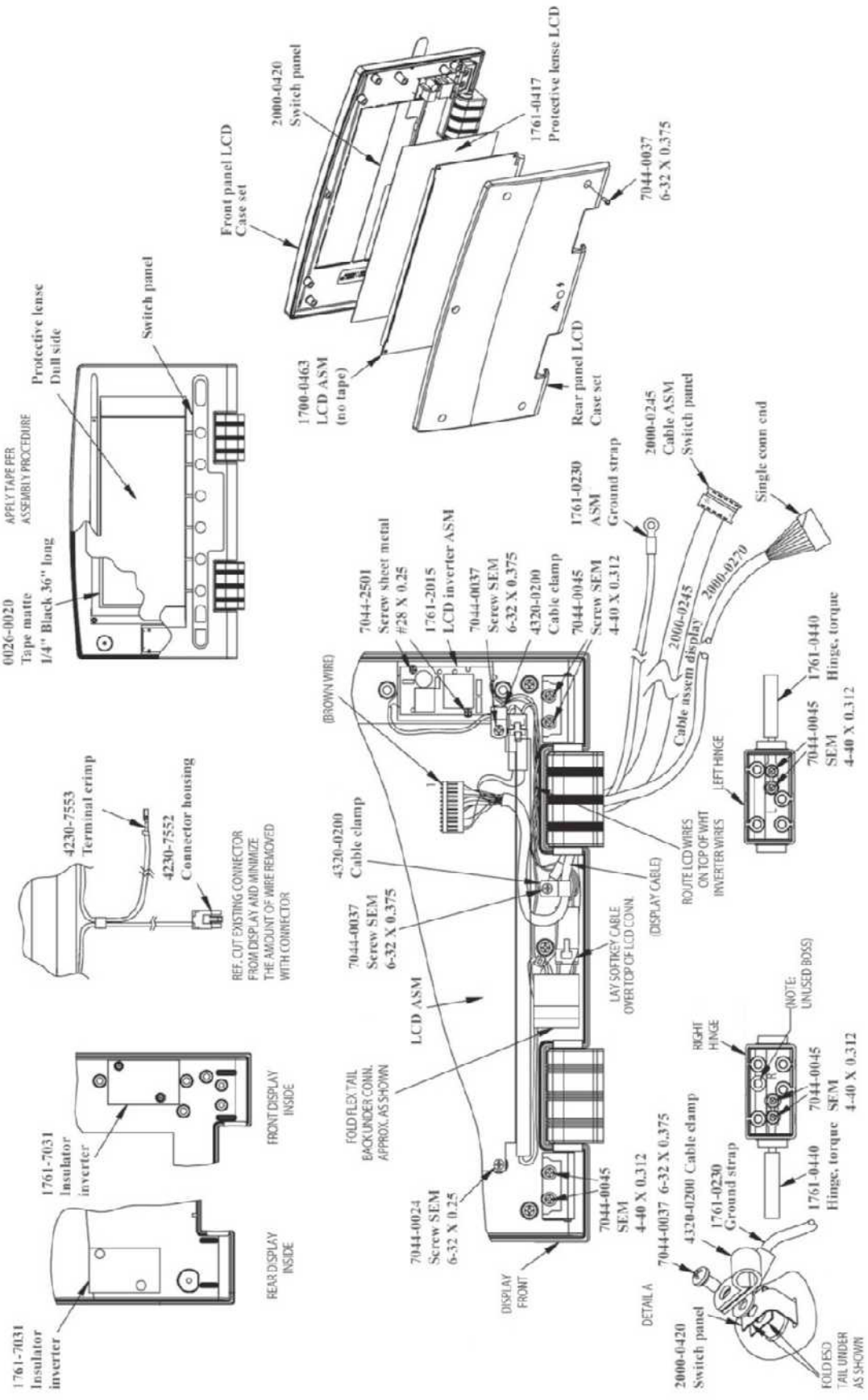

1770-0432
Label warning/standard
2000-0415
IEC Power module
2000-0433
Label rating (120 V USA)
4230-8039
Fuse Drawer
5330-1104
Fuse 3.15A
Slow blow 20mm


2000-0408
Label LCD contrast
5504-0100
Knob
5504-0101
Cap
2000-0232
Cable ASM
Contrast control
4314-0006
Clamp, cable, adhesive
2000-0232
Cable ASM
Contrast control
1761-7031
Insulator

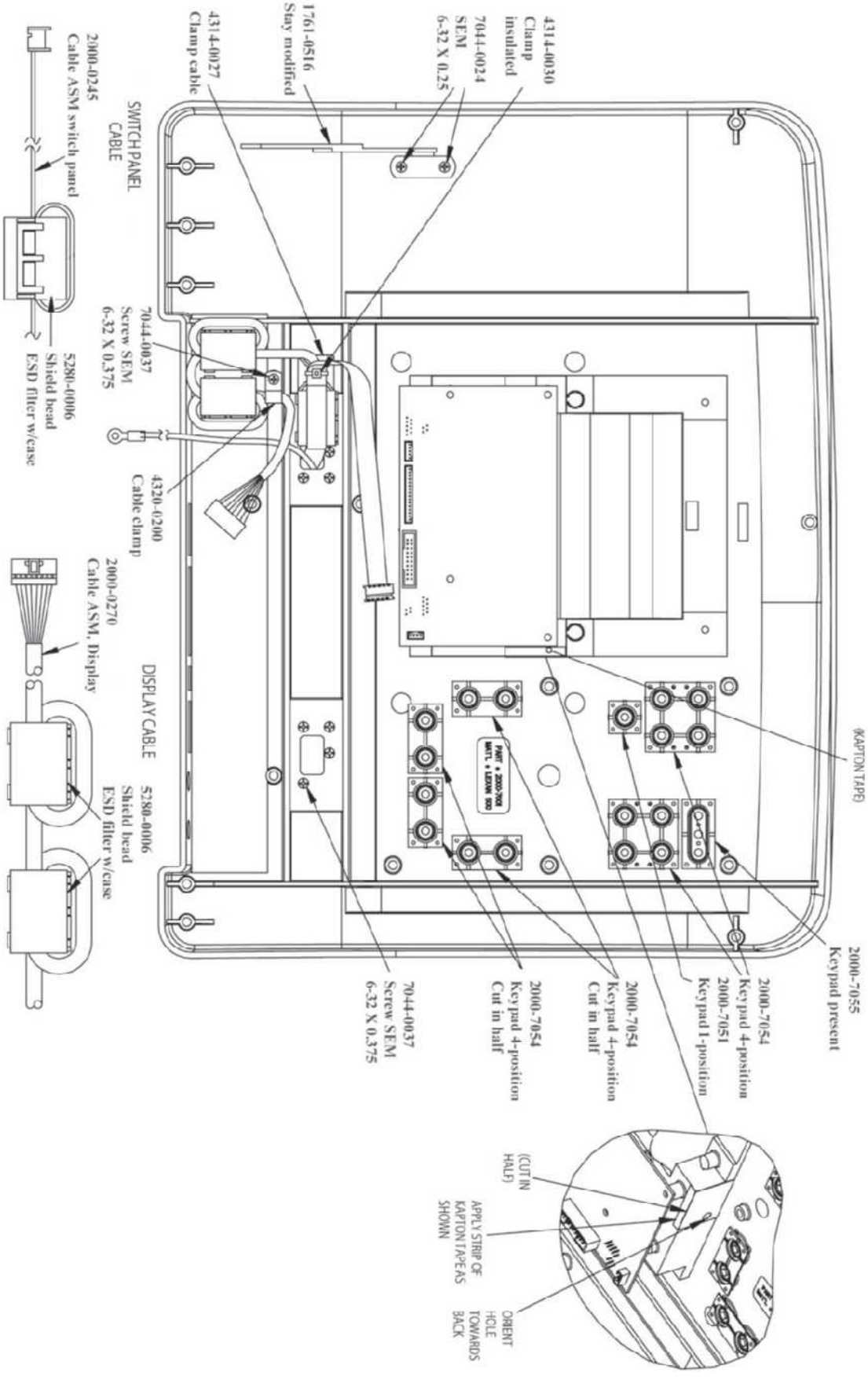
Overall assembly



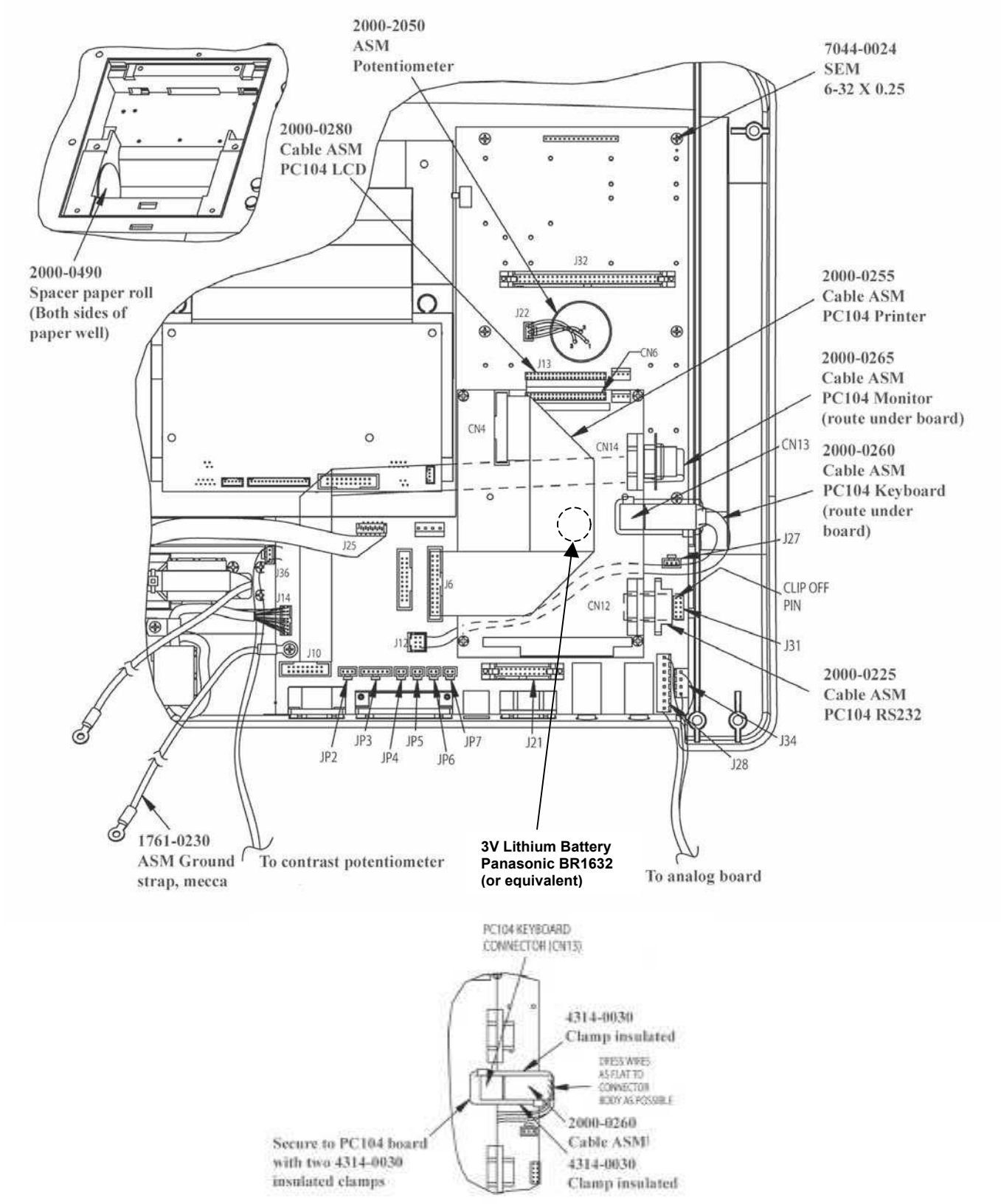
LCD assembly



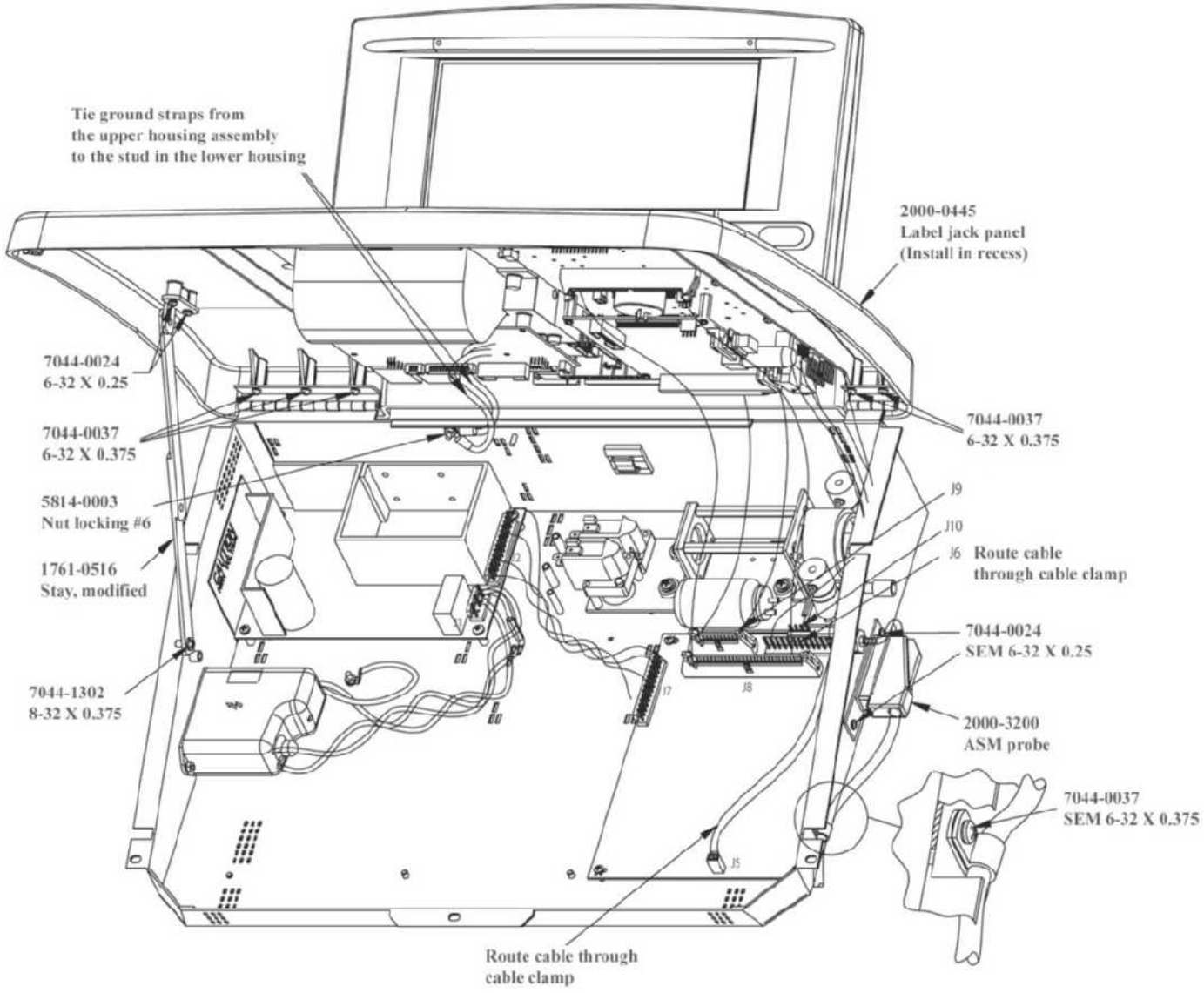
Top case assembly



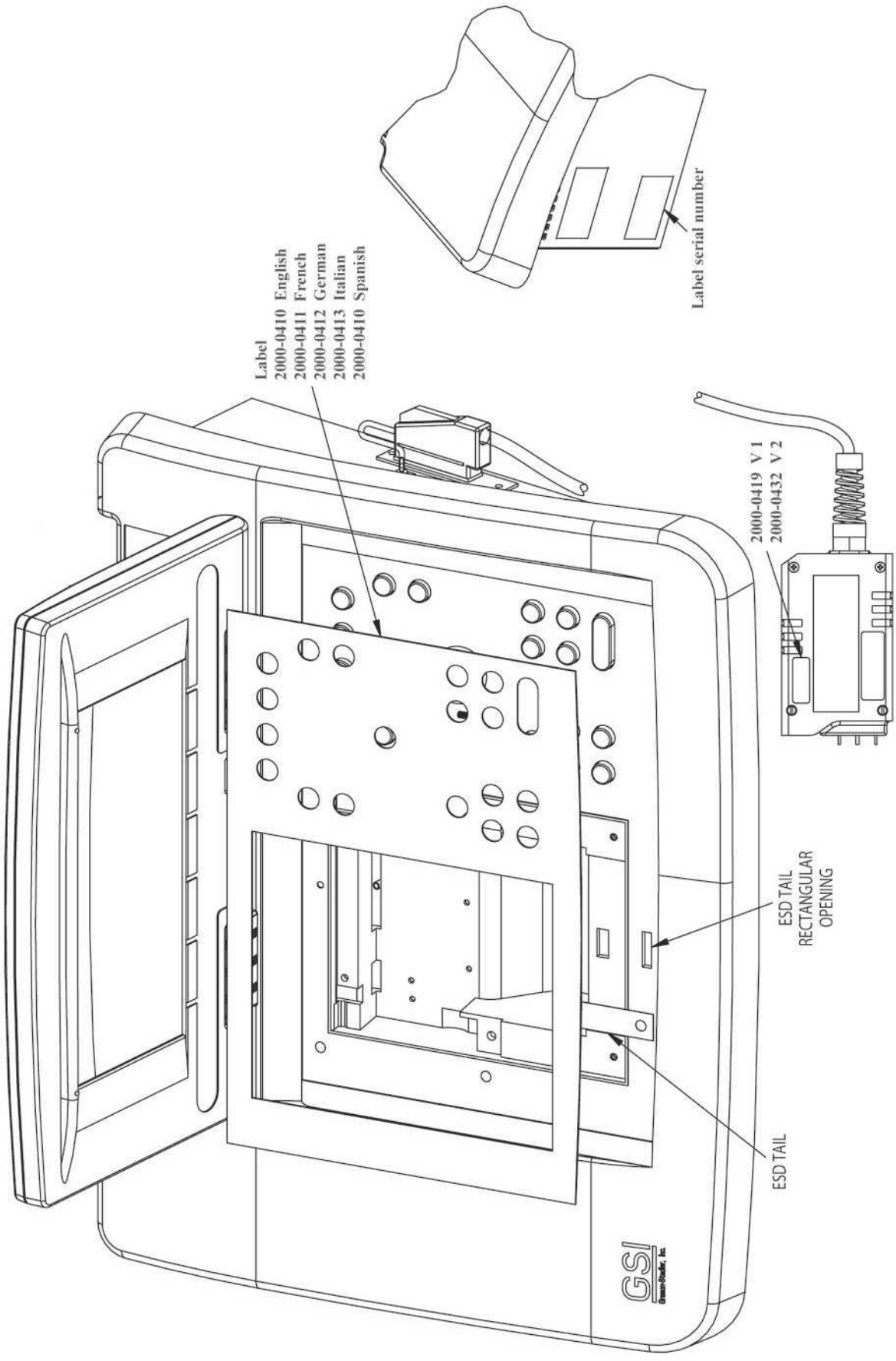
Bottom case assembly

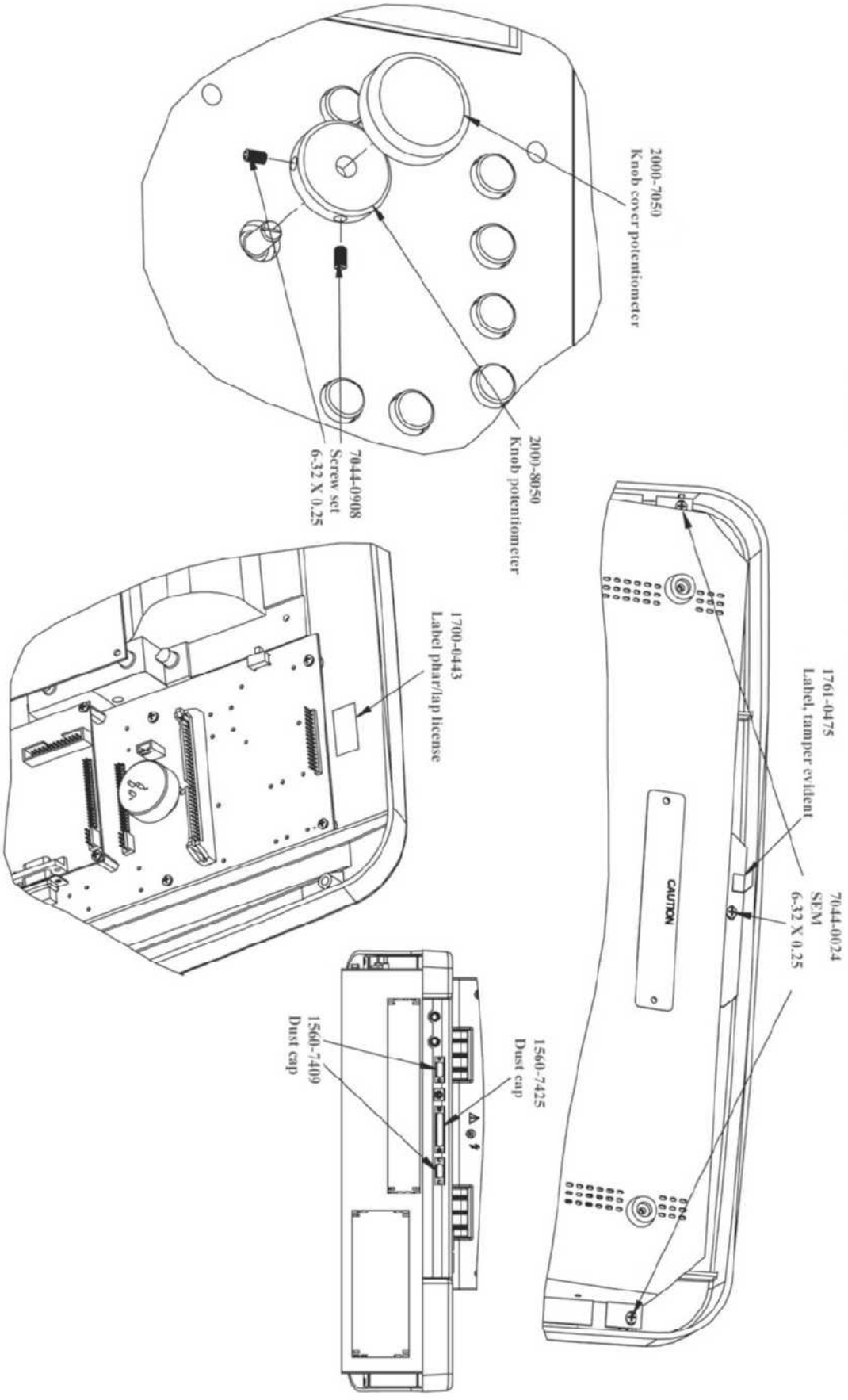


Instrument assembly

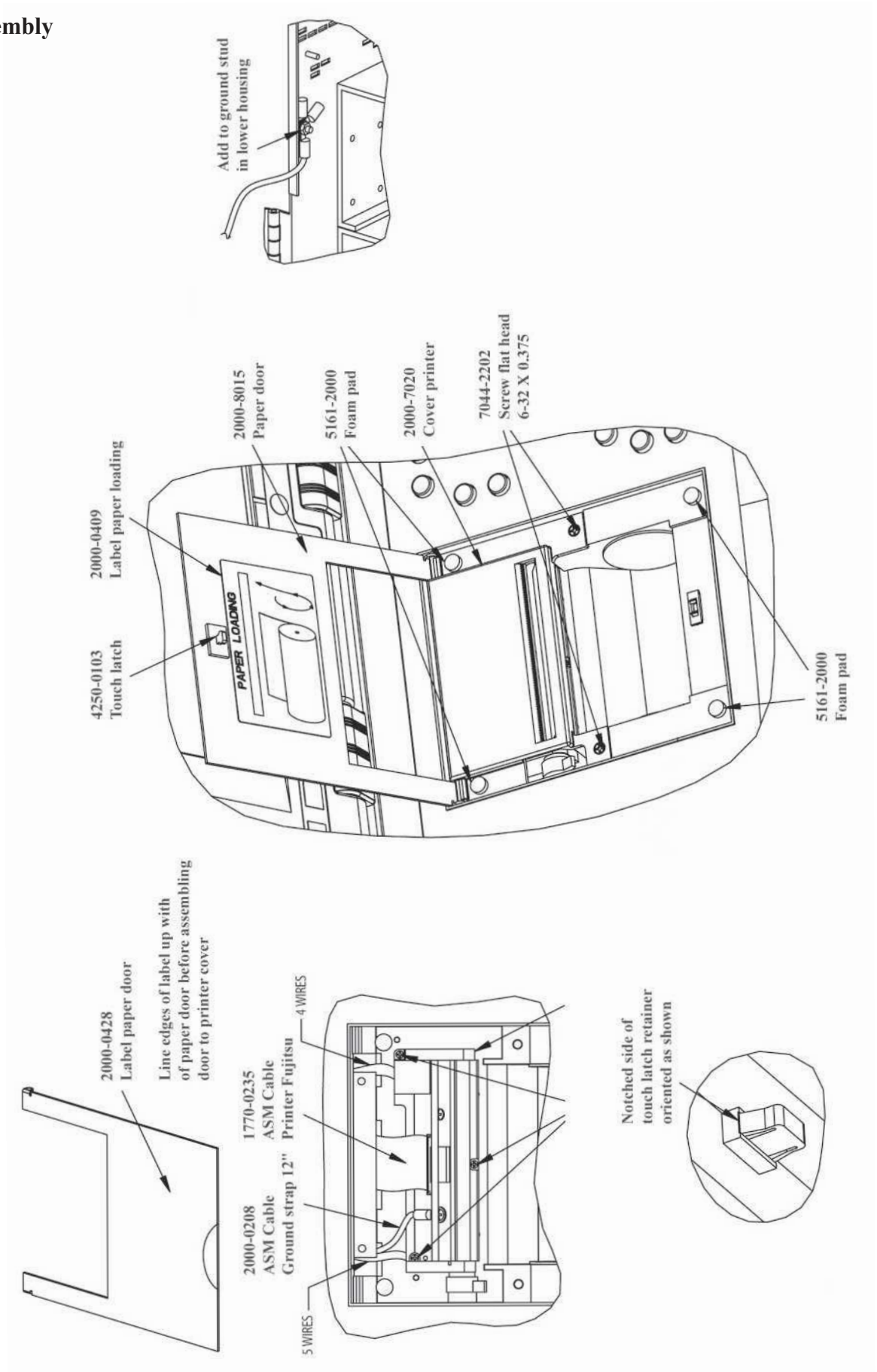


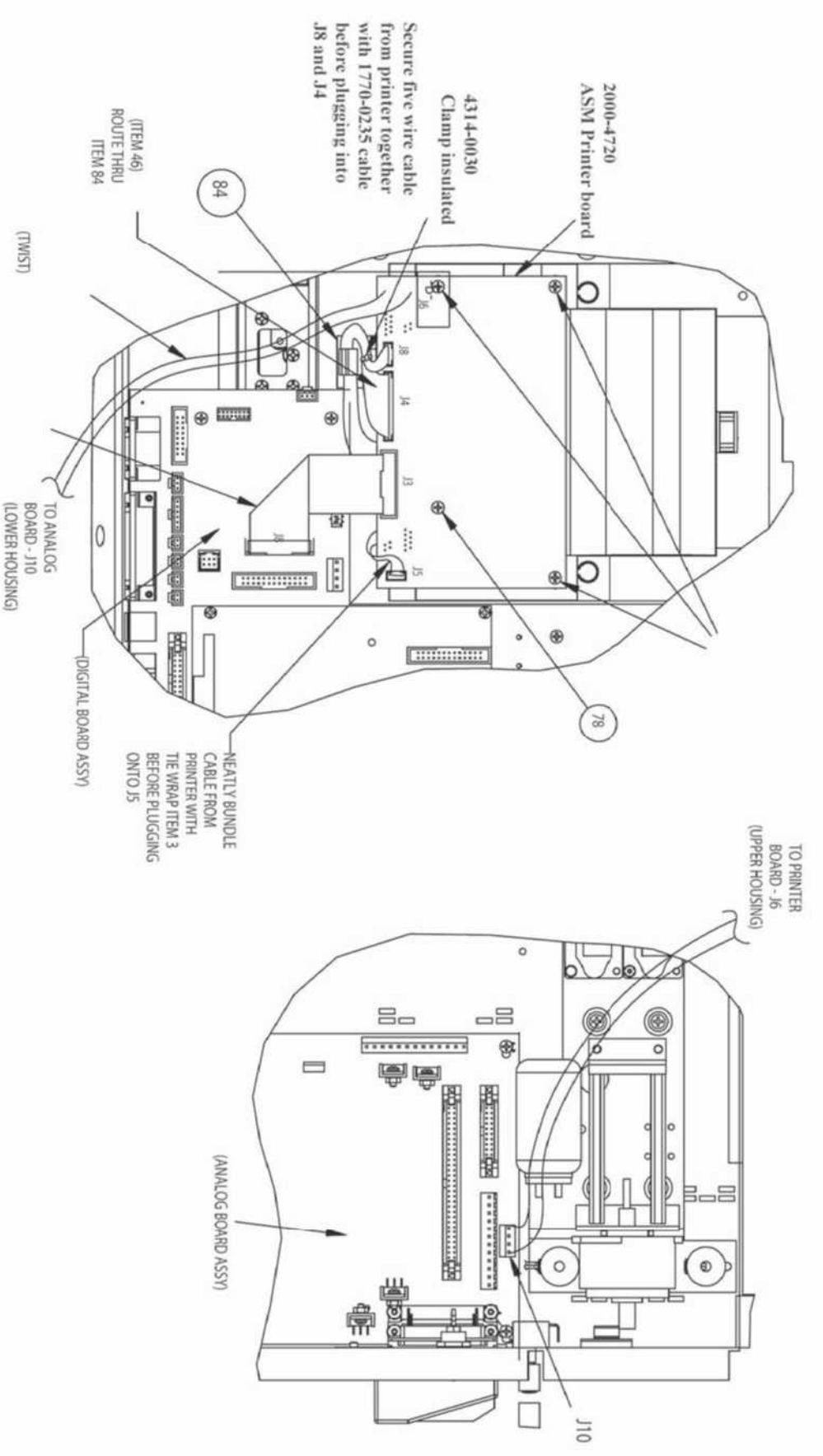
Labels


Label serial number
Label
2000-0410 English
2000-0411 French
2000-0412 German
2000-0413 Italian
2000-0410 Spanish
2000-0419 V 1
2000-0432 V 2
ESD TAIL RECTANGULAR OPENING
ESD TAIL
GSI


Fold the label in half and apply
to top and bottom case - German version only
2000-7050
Knob cover potentiometer
2000-8050
Knob potentiometer
7044-0908
Screw set
6-32 X 0.25
1761-0475
Label, tamper evident
7044-0024
SEM
6-32 X 0.25
CAUTION
1700-0443
Label phar/lap license
1560-7425
Dust cap
1560-7409
Dust cap

PrinterAssembly




2000-4720
ASM Printer board
4314-0030
Clamp insulated
Secure five wire cable from printer together with 1770-0235 cable before plugging into J8 and J4
84
(ITEM 46)
ROUTE THRU
ITEM 84
(TWIST)
TO ANALOG
BOARD - J10
(LOWER HOUSING)
(DIGITAL BOARD ASSY)
NEATLY BUNDLE
CABLE FROM
PRINTER WITH
TIE WRAP ITEM 3
BEFORE PLUGGING
ONTO J5
78
TO PRINTER
BOARD - J6
(UPPER HOUSING)
(ANALOG BOARD ASSY)
J10

Hardware description 7

General

This chapter provides system-level descriptions of the TympStar hardware and hardware interconnections. Hardware is shown as assembly diagrams, block diagrams and interconection diagrams and include typical signal levels at the input/output interfaces of factory-calibrated hardware assemblies. The chapter begins with a description of the system boot sequence.

NOTE:
GSI will make available instructions, schematic diagrams and other system drawings as it deems appropriate to be repaired in the field.

System boot sequence

Pre-CP Control

1. TympStar is turned ON - PC104 is powered and FLASH BIOS does minimal system check (RAM check, DOC present check, etc) and loads boot sector(s) of the DOC (which launches the PharLap OS).
2. At this time, the PharLap OS is not loaded, the CP.EXE program is not loaded and the SP should be held in reset. The printer board should be powered and the printer firmware should be running and idle.
3. PharLap OS boots on DOC – after OS is booted the CP.EXE program is loaded and run under the PharLap OS.
4. Once the CP.EXE program is completely loaded in memory, it begins running – after a small amount of compiler generated startup code (to initialize globals, set up stacks, etc) control is transferred to the main() routine which is the start of the CP software world.

Main()

5. The GFX (Graphics) subsystem is initialized (PharLap uses an package called PEG which is integrated into the OS). Both the LCD and CRT are driven in the proper resolution. Current FLASH BIOS has the LCD enabled (i.e. we don't have to specifically turn it on in software) so at this point, a complete reverse video screen (white on the CRT) should be shown. The graphics driver thread is started in software to handle all LCD/CRT output.
6. The TST subsystem is initialized by starting the Test thread. This is responsible for handling virtually all of the different TympStar tests (Tymp, Reflex, ARLT, etc). This thread always runs and sits idle waiting for requests to run a test.
7. The ERR subsystem is initialized – the ability to generate and log failsafe codes can be done from this point forward.

8. The DAT subsystem is initialized to allow for reading/writing of data to the Disk-On-Chip as well as the SEREE (although the SEREE is not actually accessed at this time – see below).

NOTE
SEREE is the serial EEPROM in the probe.

9. The I/O port read/write subsystem is initialized and all of the hardware I/O ports in the system are initialized with known values to bring the hardware up to a known state.
10. The FPGA is completely programmed (takes about 5 seconds) from the latest FPGA.BIN file which resides on the DOC (should be put there as part of the TympStar installation). We can detect errors programming the FPGA and failsafe as needed (NOTE – if the LCD is not automatically turned on by the BIOS, you will only see this failsafe code with the external CRT).
11. At this point the LCD is turned on. The latest BIOS enables the LCD from power-on, but on prior versions of the BIOS it was necessary to manually enable the LCD. Since this does no harm, we continue to do it in software should the BIOS ever be changed to not enable the LCD on power-on.
12. The SEREE driver is loaded – the SEREE is checked to ensure that it is ready to accept commands from the CP. The probe attached state is not checked yet.
13. The DPRAM is verified. Access to and integrity of the DPRAM is verified by performing various tests such as the Data cell individually addressable test, the Walking one data test, an the Walking zero data test. Failures are reported as failsafe codes.
14. The Probe Serial Number as stored in SEREE is read. This will also determine if a probe is attached – if no probe is attached we will still allow the normal boot, but no access to the probe is allowed and no starting of any tests are allowed. The state of the probe attached is saved globally for reference by all tasks in the system.
15. The page data is now allocated in memory – and initialized with 26 blank tests. We then check the warmstart flag in non-volatile memory (DOC)is preformed to see if the unit are recovering from a failsafe/warmstart. If so, the page data is read from the DOC and stored into the appropriate tests in page memory.
16. If the unit is not in a warmstart condition, remove any warmstart flags and page data from non-volatile memory (both stored on the DOC).
17. The pump driver timer is loaded by the system with 125us timing resolution. The pump driver is loaded later.
18. The RS232 port UART is initialized and the low level HW driver for received serial characters is loaded. The baud rate and related settings are not set until later (when the user saved instrument options are read from DOC).
19. The A/D conversion thread is loaded (for allA/D reading and this also calls the Watchdog monitor routine; however, the watchdog is not yet running).
20. The Housekeeping thread is loaded (for basic system timing tasks, misc HW checks, keyboard processing, etc) .

21. The Remote thread is loaded (to handle both incoming and outgoing serial packets).
22. The Key thread is loaded (to handle both hardkeys and softkeys but not keyboard).
23. The Plotting thread is loaded (to handle graphics plots during testing).
24. The DPRAM thread and ISR are loaded to handle DPRAM interrupt requests.
25. The Printer thread is loaded and the printer buffers are initialized (print functionality is now available from this point forward).
26. The printer is then initialized – and the unit checks for the presence of the Internal printer (a printer SELECT line is used for this). Globals are updated in memory to let the rest of the system know if the internal printer is present.
27. The watchdog is now enabled as long as the unit is entering NORMAL mode (check dipswitches). In CAL or DIAG mode, we keep the watchdog disabled. From this point forward in NORMAL mode, we will be strobing and checking the watchdog looking for possible system failures (will failsafe if the watchdog check fails).
28. Now the low-level system is initialized - control is passed to the set_op_mode() function which can now use all of the drivers and threads in the system.

Set_op_mode()

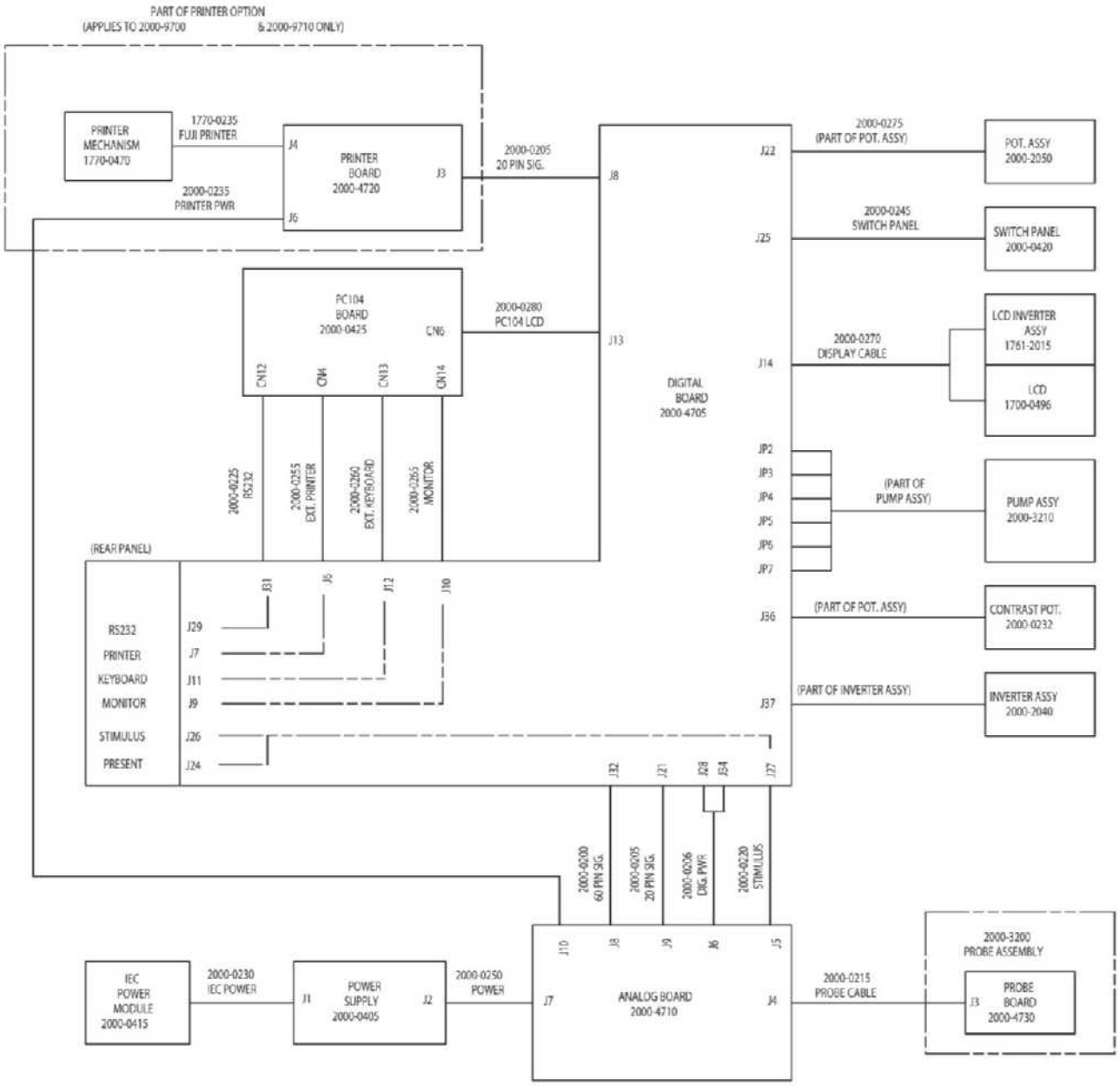
29. The unit checks to ensure that this CP.EXE application version is legal – that is a V2 system must have a valid lock and key code existing on the DOC. If not, the system will bypass the normal startup and enter the user directly into the V2 lock/keycode entry menu.
30. Instrument Options are read – all user stored values are read from DOC (if they don't exist or are an invalid version failsafe is implemented – this is a COMMON failure when upgrading systems – if the release notes state that user data files have changed, new GSI USER/KEY data must be loaded through the CAL DE-FAULTS menu). If entering CAL mode, the read of Instrument Options is omitted (since the user might need to reload them).
31. During instrument options read – the UART is initialized with the proper baud rate settings. The date and time format is updated – the unit is now ready to display time on the upper corner of the screen.
32. The "GSI TympStar" logo is displayed on the LCD and CRT (both driven at the same time). This is the first graphic output to the LCD/CRT since it was initialized.
33. Version numbers and SN are displayed next. The CP rev, Probe S/N, FPGA rev are displayed as those systems are up and running. The SP is not running yet.
34. The SP is initialized and started running (taken out of reset).
35. The SP Rev is obtained from the DPRAM and displayed to the LCD/CRT.
36. The SEREE is read in its entirety and copied to CP shadow memory for fast lookups as requested by the CP and SP. This takes about 12 seconds.
37. The pump system is now homed. This is the first pneumatic system movement. We check to ensure that the pump is in the home position.
38. Send the click-rate as stored on the DOC to the SP.

39. The TYMP hardkey is now simulated to start the system on the TYMP test screen. This complete the power-up and enter the TYMP test mode (handled in tymp_sk()).
40. Control is passed to the tymp test routines. T he remaining power up sequences are completed.

Tymp_sk()

41. Altitude information is read from the probe SEREE. Calculates site altitude occlusion and probe in ear limits are calculated.
42. Initialize current RTL values from either GSI default RTL or USER selected values. If error reading RTL values, GSI defaults are loaded.
43. The unit we reads the CAL/DIAG/NORMAL run switch and determine s the mode -normal mode, calibration mode or diagnostics mode and for the latter two, the appropriate sequence is applied to enter into cal/diag.
44. The SP to calculates the CK numbers necessary to perform tests, etc. This takes the SP about 12 seconds.
45. The LCD/CRT is cleared of text/logos.
46. The Green LED on the probe is started in a blinking pattern.
47. Now the Tymp template screen is drawn, the menu is drawn and enabled, keyboard is enabled and the system should be idle in the Tymp test mode. Soft and Hard Keys are now active – user can navigate and run tests.

Interconnection diagram



Block diagram description of assemblies

A block diagram of the TympStar is shown on the following pages. The block diagram and block diagram description outlined below are only intended to assist in the recognition and assembly-level troubleshooting of major assemblies. Component-level troubleshooting and parts replacement should only be performed by GSI service technicians at the factory.

The TympStar is comprised of the following 9 major assemblies:
- LCD
- Printer
- Probe
- Pump
- Digital board
- PC104 board
- Analog board
- Power supply board
- Printer board

LCD assembly

The LCD assembly is comprised of the following:
- The liquid crystal display
- Controller circuitry
- Backlight inverter board

Printer

The printer is comprised of the following:
- Paper advance motor
- Paper "present" photo eye
- Fixed thermal head

Probe

The probe is comprised of the following:
- Two speakers, an IPSI stimulus speaker and a probe tone speaker
- One microphone assembly for measuring the reflected probe tone signals
- One pressure transducer assembly for monitoring the pneumatic system pressure
- One flash ROM for storage of probe related calibration data

Pump

The pump is comprised of the following:
- A stepper motor with a linear shaft driven by a "worm gear"
- A bellows assembly attached to the motor shaft for generation of positive and negative pressures
- A positive and a negative over-pressure sensor switch which prevent excessive pressures
- Vent and hold valves

Digital board

The digital board contains the measurement circuits and general interface to all other sub assemblies and consists of the following:

- Signal microprocessor
- FPGA– Field Programmable Gate Array
- Microphone signalA/D converter
- Pressure levelA/D converter
- Dual port RAM that provides signal and control processor intercommunication
- Watch dog timer circuit for monitoring hardware and software performance
- Interface to the PC 104 board, analog board, printer board, LCD, internal and external printers, internal and external keyboards, isolated RS232 port and pump control circuitry
- Calibration mode entry and option switches

PC104 board

The PC104 board serves as the control processor for the TympStar. It is an all-in-one single-board computer. This 486-based PC interprets and responds to the keyboard commands and it manipulates the measurement data for display and printing. The PC104 board includes the following:

- Embedded AMD DX5-133 processor (Pentium grade)
- ISA interface to digital board
- Award 128 KB flash BIOS
- System memory 4 MB RAM in SIMM socket
- Supports M-Systems DiskOnChip® 2000 flash disk up to 144 MB
- Enhanced IDE hard disk interface
- RS232 serial port
- Parallel printer port which supports SPP/ECP/EPP modes
- Keyboard/mouse connector
- VGA interface

Analog board

The analog board contains all the tone and noise generators and amplifiers as well as the microphone filters along with all the signal multiplexes including the following:

- Multi-frequency probe tone generation
- Multi-frequency microphone filters
- IPSI tone generation
- Contra tone generation
- Noise generation
- Click generation
- Probe tone, IPSI and contra amplifiers
- Probe interface
- Signal multiplexing for probe tone, microphone, reflex stimuli and pressure signals

Power supply board

The power supply is a UL2601, CSA22.2 and IEC 601.1 approved switching power supply. The various supply outputs are as follows:

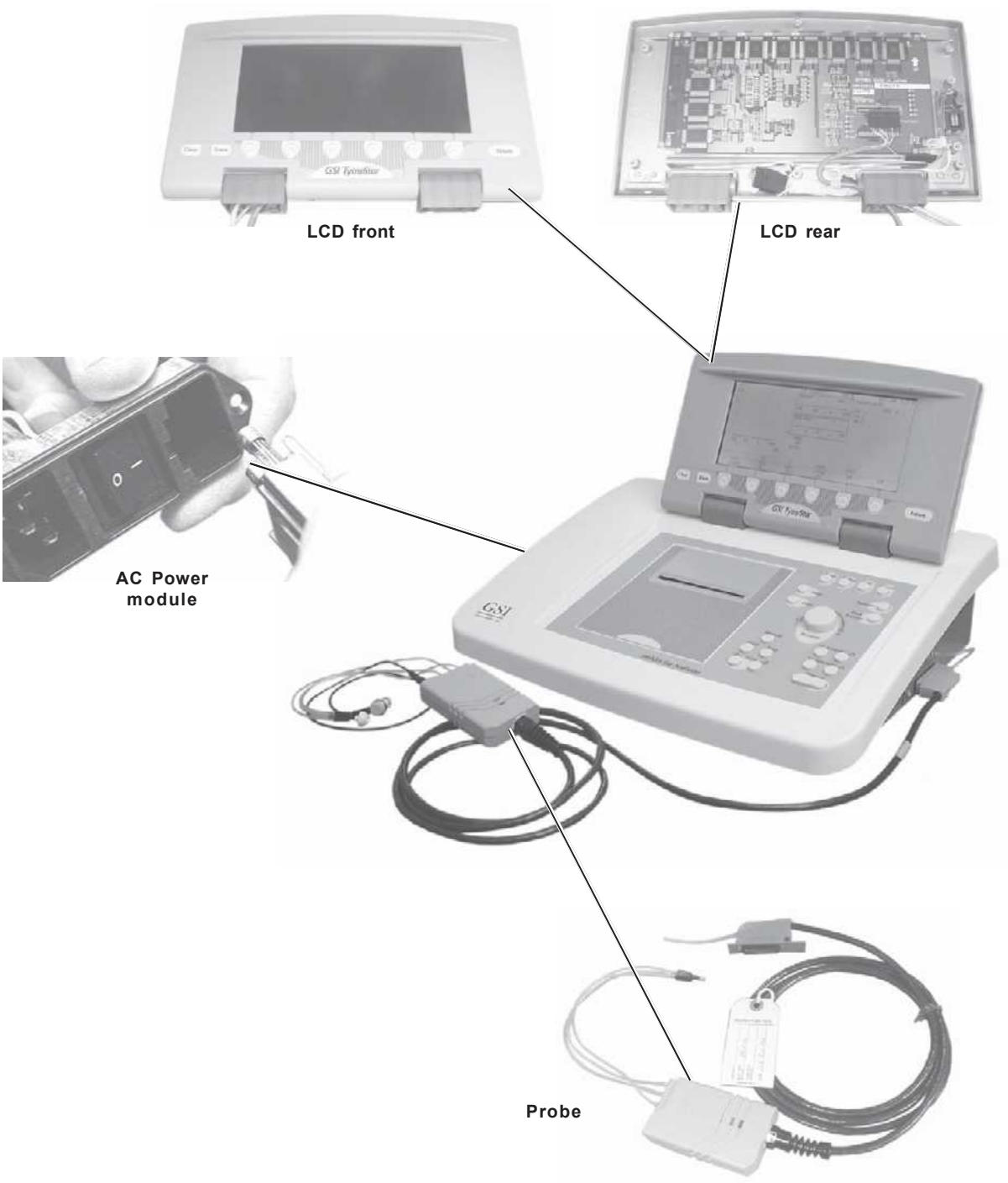
- +5V +/- 2% rated for 12Amp continuous load
- +24V +/- 10% rated for 3.5Amp continuous load
- -12V +/- 3% rated for 1Amp continuous load
- +12V +/- 3% rated for 2Amp continuous load

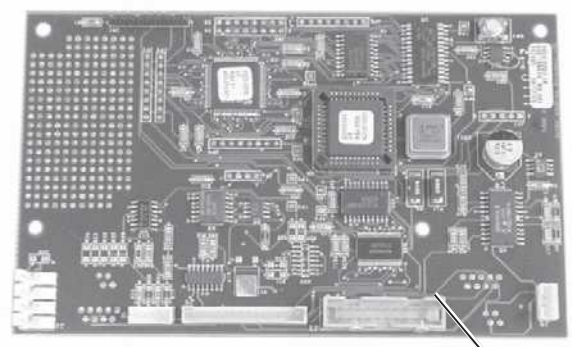
Printer board

The printer board contains the printer motor control circuits, the printer head control circuit and the code for appropriate printing of data for both the internal thermal printer and an external HP printer . The printer board includes the following:

- Microprocessor for translation of print data for appropriate format for internal and external
- CPLD – Complex Programmable Logic Device uses µProcessor data to control motor and print head
- EEPROM stores the code for translation of the data

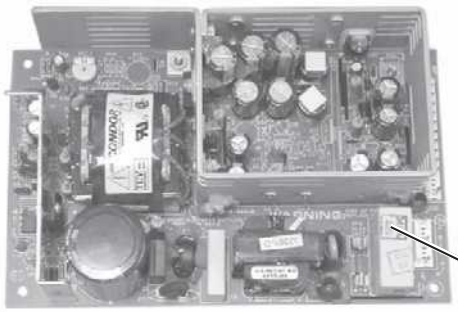
System assembly diagram



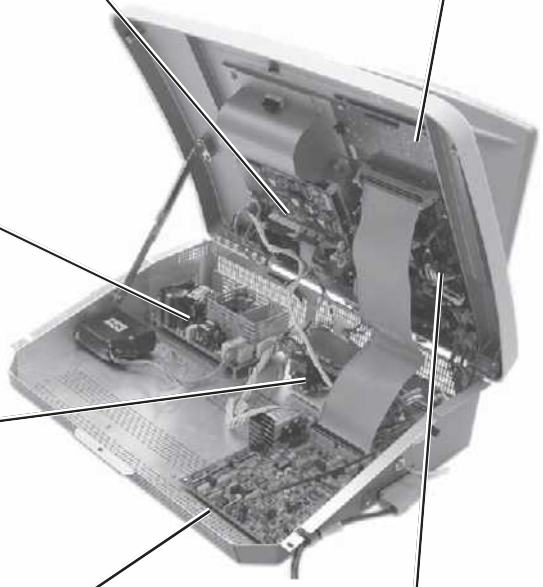


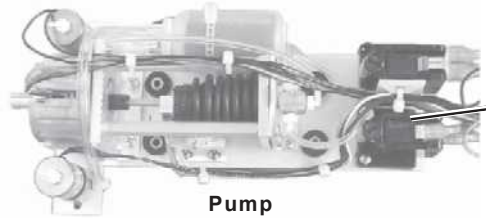
Printer board

Digital board

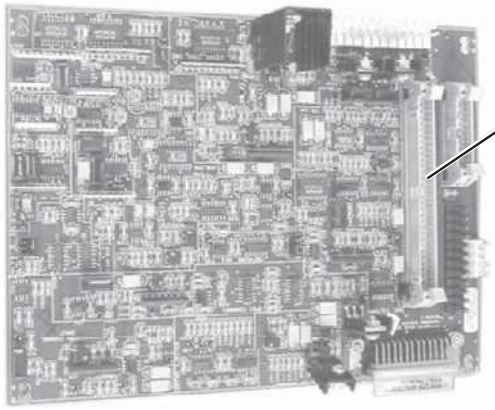


Power supply board

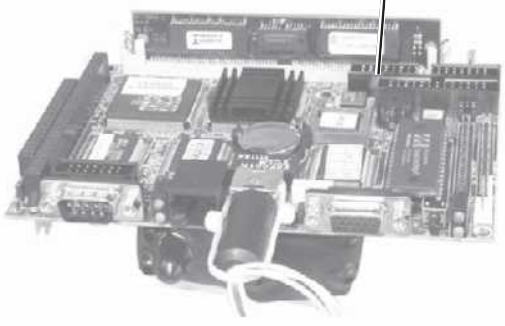




Pump



Analog board



PC 104 board

Troubleshooting 8

This chapter provides descriptions of the following:

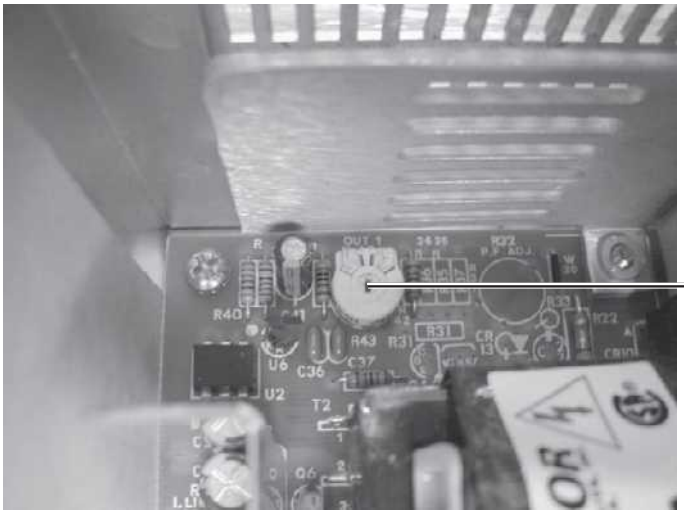
System power supply measurements

Power Supply (J2)

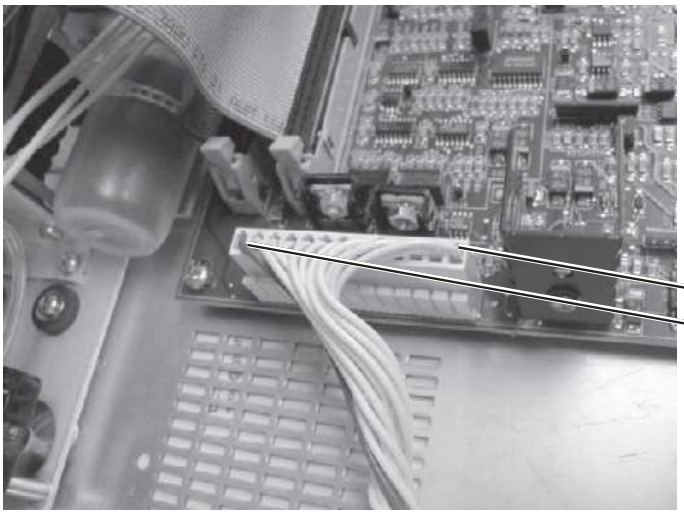
Pins 1,2,3 =+5.00 Volts DC
Pins 4,5,6,7 ground reference
Pins 8, 9 =+24 VDC
Pins 10,12= 0VDC
Pin 11= -12VDC
Pin 13= +12VDC

Reference J2 - Set to +5.00 (+or-10mVDC)

Power Supply (set +5VDC)

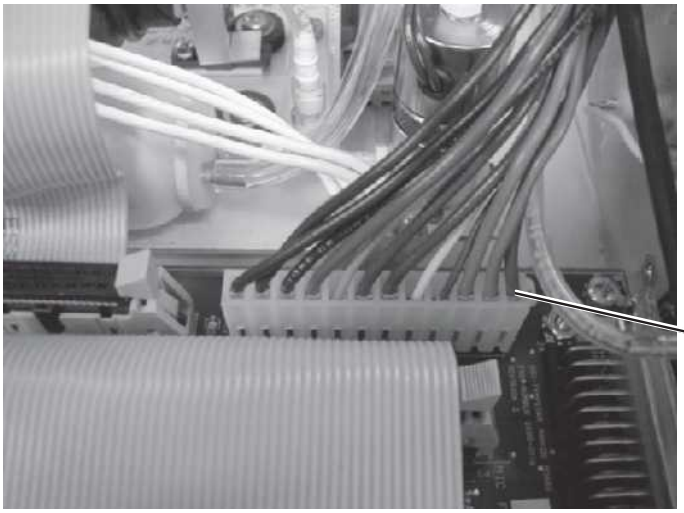


Analog Board (J7)



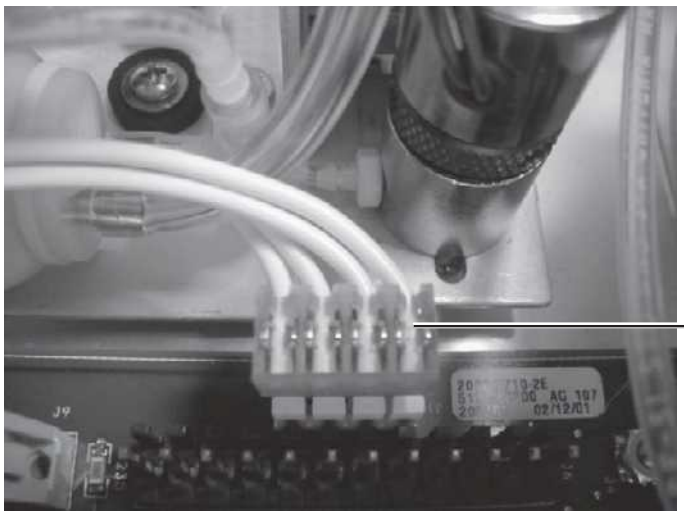
Pins 1,2,3 = +5.00 Volts DC
Pins 4,5,7 ground reference
Pins 8, 9 = +24 VDC
Pins 10,12= 0VDC
Pin 11= -12VDC
Pin 13= +12VDC

Analog Board (J6)



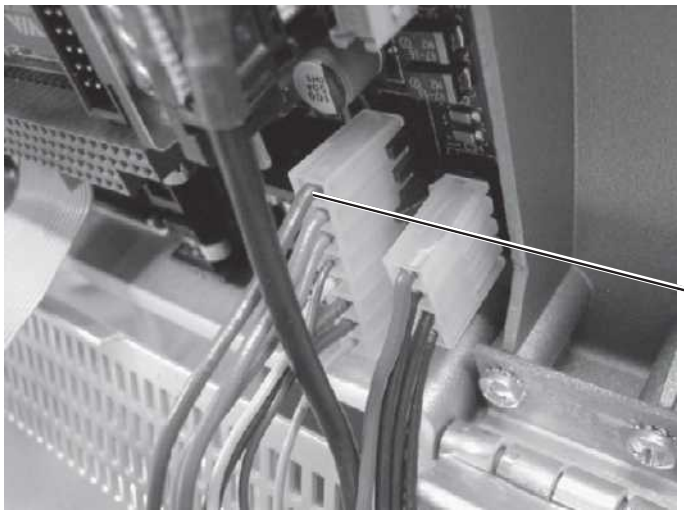
Pin 1=+24VDC
Pins 2,3= ground reference
Pin 4=+12VDC
Pin 5= -12VDC
Pins 6,7= ground reference
Pins 8,9= -5VDC
Pins 10,11,12= ground reference

Analog Board (J10)



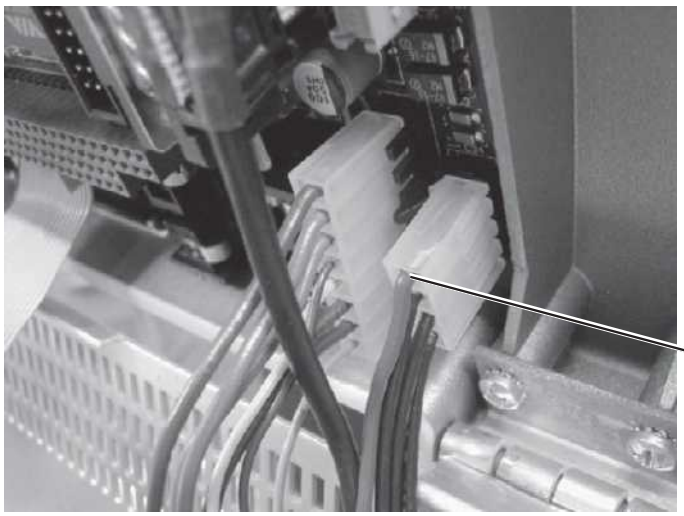
Pin 1=+24VDC
Pin 2= ground reference
Pin 3= +5.00VDC
Pin 4= ground reference

Digital Board (J28)



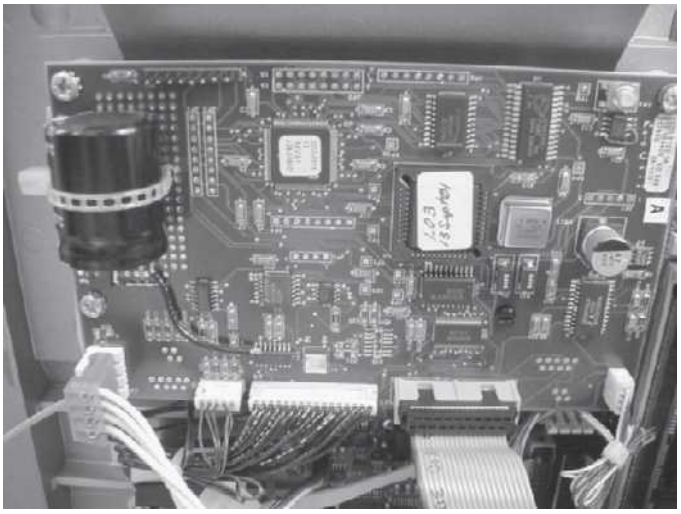
Pin 1= +24VDC
Pin 2,3= Probe Ground
Pin 4= +12VDC
Pin 5= -12VDC
Pin 6,7= Ground Reference
Pin 8= +5.00VDC

Digital Board (J34)

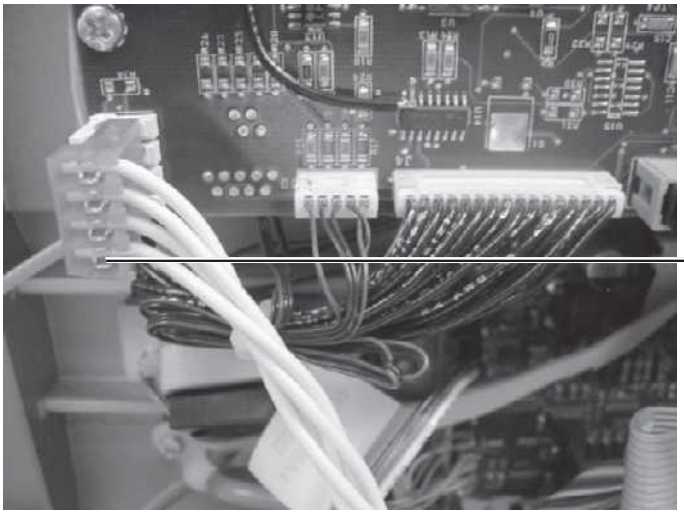


Pin 1= +5.00VDC
Pin 2,3,4=Ground Reference

Printer Board
(Full View)

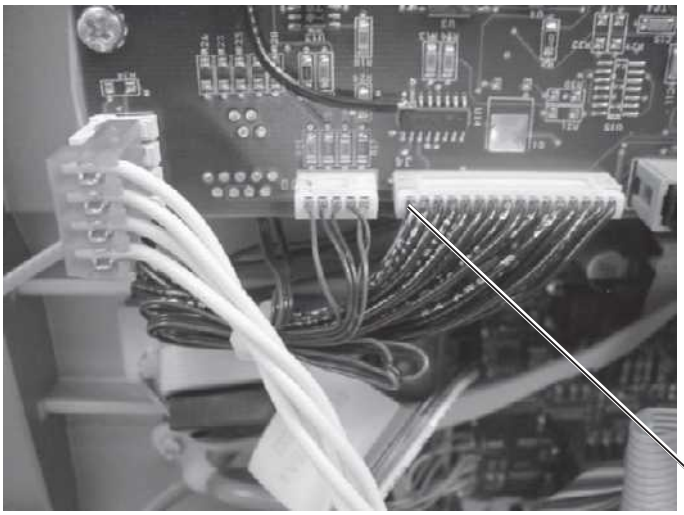


Printer Board (J6)



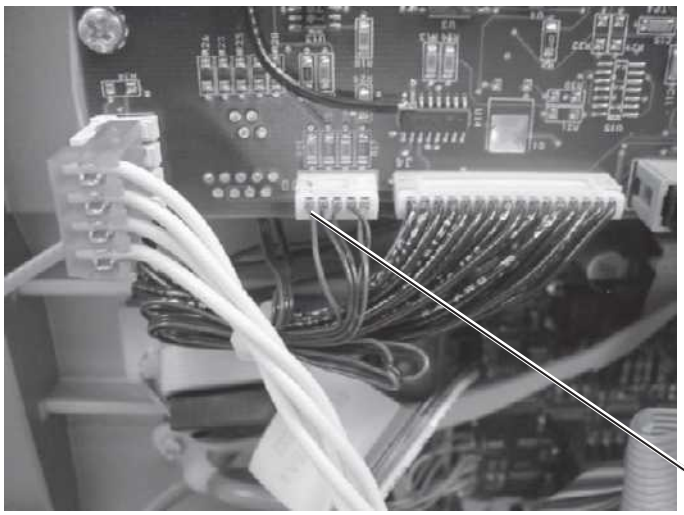
Pin 1=+24VDC
Pin 2=ground reference
Pin 3=+5.00VDC
Pin 4= ground reference

Printer Board (J4)



Pin 1,2= +24VDC
Pin 3,4= ground reference
Pin 5,6,7= STROBE 1,2,3
Pin 8= THERMISTOR
Pin 9= STROBE 4
Pin 10= PRTLATCH
Pin 11= STROBE 5
Pin 12= +5.00VDC
Pin 13= PRTCLK
Pin 14= PRTDATA
Pin 15= ground reference
Pin 16= +24VDC

Printer Board (J8)



Pin 1= +5.00VDC
Pin 4= ground reference

Pressure Potentiometer (Digital Board)

Pin 1(Red)= Ground Reference
Pin 2(White)= @+200dapa= +4.29VDC
@-400dapa= +3.84VDC
Pin 3(Black)= +5.00VDC

Error Codes

Error codes are alphanumeric and are generated by the Control Processor (CP) on the PC 104 board and the Signal Processor (SP) on the Digital board. The Control Processor is the main host computer and controls the overall operation of the instrument. The Signal Processor controls the signal routing and measuremant process.

CP Error codes

Code	Name	Description
1000	ABORT_DPRAM_FAIL	DPRAM - Dual Port RAM memory test failure Subcodes: None. Likely Causes: Most likely hardware failure with DPRAM on Digital board or any address/data lines that run to the DPRAM.
1100	ABORT_KEY_INVALID	Invalid keycode detected – keycode out of range. Subcodes: keycode detected. Likely Causes: This is one of the internal checks for the keyboard handler. This indicates an internal software failure.
1101	ABORT_KEY_PROC_BAD	Invalid keycode handler function detected by menu handler. Subcodes: keycode that is currently being processed. Likely Causes: This is one of the internal checks for the keyboard handler. This indicates an internal software failure.
1102	ABORT_KEY_TOO_MANY_KEYS	The key queue has filled and additional keys are detected that cannot be stored by the software. Subcodes: keycode of the last key that attempted entry into the queue. Likely Causes: The key queue is very large and keys cannot be pressed fast enough to fill it. This is most likely a hardware problem with keys. It could also mean that the CP software (PC104) has stopped processing keys, but continues to queue them up until the buffer fills (this is less likely).
1200	ABORT_SP_FAIL	SP does not respond to communication request by CP Subcodes: none Likely Cause: When the system is first booted, the DPRAM is enabled and the SP is taken out of reset (i.e. initialized) and must respond to the CP's communication request within 30 seconds. If the SP does not respond, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
1201	ABORT_SP_TIMEOUT_ON_CMD	Timeout on wait for SP to complete the last set of commands. Subcodes: command opcode Likely Cause: There are numerous commands that travel between the CP and SP; if the SP is not responding for any reason this error code will likely occur. It is most likely a problem with the SP itself (for example, if the SP gets reset by high-current power spike) or with a faulty hardware path between the SP and CP.

CP Error codes

1202	ABORT_SP_FAILED_TO_RUN	SP never started running after reset. Subcodes: none Likely Cause: When the system is first booted, the DPRAM is enabled and the SP is taken out of reset (i.e. initialized). We can detect the SP state of being initialized since the SP writes to key DPRAM locations that we monitor. If the SP does not initialize, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
1203	ABORT_SP_TIMEOUT_ON_CMD_WAIT	Timeout on wait for SP to complete current "blocking" command. Subcodes: none Likely Cause: There are numerous commands that travel between the CP and SP; if the SP is not responding for any reason this error code will likely occur. It is most likely a problem with the SP itself (for example, if the SP gets reset by high-current power spike) or with a faulty hardware path between the SP and CP.
1300	ABORT_INST_OPT_BAD_CTSRTS_STATE	Instrument Options - CTS/RTS selection invalid. Subcodes: none Likely Cause: This is an internal check for the CTS/RTS menu handler. The user should never be allowed to select any CTS/RTS choice except those presented on screen, so this indicates an internal software failure.
1400	ABORT_MNU_INVALID_KEYCODE	Menu handler - invalid (non soft-key) keycode received. Subcodes: keycode Likely Causes: This is an internal check for the softkey value passed into the main CP menu handler. This key is expected to be one of the 6 softkeys (SK1-SK6) and if it is another hardkey, it should have been handled previously. This indicates an internal software failure.
1401	ABORT_MNU_INVALID_REPEAT	Menu handler - invalid key status (repeat key detected) Subcodes: keycode Likely Causes: Repeated softkeys are handled at different layers. The menu handler does not deal with repeated keys and so will failsafe with this code should a repeat key be passed to it. This indicates an internal software failure.
1500	ABORT_TESTTSK_INVALID_MSG	An invalid message type was received by the test task scheduler. Subcodes: message type Likely Causes: This error occurs when the Test Task receives a message request that it cannot process. There is a software look-up table of test procedures that can be run as part of a test task, if a request comes in to run something that is not on this list, this failsafe will occur. This is an internal check and indicates an internal software failure. It is also possible that either the Test Task or the calling task have corrupted stack memory that led to this error. It is also possible that the PharLap tasking code has errored, but this is less likely.
1600	ABORT_PAGE_NOT_AVAIL	Page - try to store a test but no pages available in memory. Subcodes: 0 = num_free_pages = 0 1 = num_free_pages > 0 but all pages indicate already data stored. Likely Causes: This is an internal check; problems indicate an internal software failure. Corrupted CP memory could also account for this.

CP Error codes

1700	ABORT_PROBE_GAIN_TIMEOUT	Timeout on wait for SP to set the probe tone gain to the specified level. Subcodes: 0 = SP does not complete 75 dB AGC (3 seconds) 1 = SP does not start sending compliance data after completing AGC (15 seconds) Likely Causes: SP failure is the most likely cause or problems in the hardware path between SP and CP (including DPRAM). An erroneous SP reset could also account for the problem.
1701	ABORT_PROBE_GAIN_INVALID_DB_SPL	Invalid SPL level parameter received in attempting to set probe gain. Subcodes: received SPL level parameter Likely Causes: This limit check should never be exceeded (the only allowed values are 75dbSPL and 85dbSPL) so the most likely cause for this failure would be an internal software failure such as a memory/stack corruption.
1900	ABORT_REMOTE_TXTEST_FAIL	Unsuccessful call to the communication task layer for transmission of test data. Subcodes: none Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.
1901	ABORT_REMOTE_TXTEST_FAIL2	Unsuccessful call to the communication task layer for transmission of test data. Subcodes: none Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.
1902	ABORT_REMOTE_TXTEST_FAIL3	Unsuccessful call to the communication task layer for transmission of test data. Subcodes: none Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.
1903	ABORT_REMOTE_TXDONE_FAIL	Unsuccessful call to the communications task layer when transmission is completed. Subcodes: none Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.

CP Error codes

1904	ABORT_REMOTE_TXERROR_FAIL	Unsuccessful call to the communications task layer when sending an error message to the remote device. Subcodes: none Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.
1905	ABORT_REMOTE_MODECNG_FAIL	Unsuccessful call to the communications task layer when trying to remote message during a mode change Subcodes: 0 = change to STOP mode 1 = change to HOLD mode 2 = change to START mode 3 = change to CONTINUE mode Likely Causes: The communications task layer has indicated that it could not process the request in the current state. Protection at the high level should prevent this from happening (for example, you cannot transfer data remotely while printing) but if this low level should detect a problem then this failsafe code can occur. This indicates an internal software failure.
2100	ABORT_MULTI_FREQ_TIMEOUT	Timeout by the SP while processing a multiple frequency probe tone during a command sent from the CP. Subcodes: probe tone frequency in Hz Likely Causes: If the SP is not responding for any reason during the multi-Hz frequency sweeps this code will likely occur. It is probably a problem with the SP or with a faulty hardware path between the SP and CP.
2200	ABORT_WDOG_CP_TRIPPED	CP Watchdog tripped. Subcodes: none Likely Causes: A CP software task may have stopped running or may be stuck in an infinite loop. Most likely an internal software failure but could be corrupted memory/stack. It could be a problem with the FPGA responsible for the watchdog timer and control lines, or with the hardware path from FPGA to CP.
2201	ABORT_WDOG_SP_TRIPPED	SP Watchdog tripped. Subcodes: none Likely Causes: The SP watchdog is also located within the FPGA. If the SP watchdog trips, the SP is held in reset and the CP is informed of the failure (which produces this code). It could be that the SP stopped running or got into an infinite loop but by the time this code occurs it will be held in reset. The most likely cause of failure is internal to the SP, or the watchdog path between the SP and FPGA. It could be a problem with the FPGA itself responsible for the SP watchdog timer and control lines to the SP and to the CP.

CP Error codes

2300	ABORT_FPGA_PROGRAM_READBACK_FAIL	FPGA Failed to program correctly. Subcodes: none Likely Causes: During bootup, the CP software reads the FPGA.BIN file from disk and programs the FPGA one byte at a time (through the parallel port). At the end of the programming sequence, a known special byte pattern is requested from the FPGA; if this fails, the FPGA is not running. Possible causes are faulty FPGA hardware, a bad connection between the FPGA on the digital board and the PC104 (there is a ribbon cable that runs between them). It could also be a faulty FPGA.BIN file on the disk but that is less likely.
2302	ABORT_FPGA_PROGRAM_STATUS_FAIL2	FPGA indicating bitstream failure during writing of FPGA.BIN. Subcodes: none Likely Causes: The FPGA is programmed one byte at a time by the CP software. During the programming, after each byte is written the status line is checked to ensure that the FPGA is still accepting data. If the FPGA status indicates it is not still programming, this error code is generated. The most likely problem is a faulty FPGA or the entire parallel data path from the PC104 to the FPGA (there is a ribbon cable that runs between them).
2400	ABORT_DAT_BAD_READ_ITEM	Data read item invalid Subcodes: none Likely Causes: The data file system was asked to read an item that it does not recognize. There is a look-up table that describes all of the possible data read/write items (both to binary files on the disk, INI files on the disk and to SEREE on the probe). If the software requests access to an item that is not listed in the look-up table, this failure occurs. The most likely cause is an internal CP software failure or possibly a corrupt memory/stack.
2401	ABORT_DAT_BAD_WRITE_ITEM	Data write item invalid Subcodes: none Likely Causes: The data file system was asked to read an item that it does not recognize. There is a look-up table that describes all of the possible data read/write items (both to binary files on the disk, INI files on the disk and to SEREE on the probe). If the software requests access to an item that is not listed in the look-up table, this failure occurs. The most likely cause is an internal CP software failure or possibly a corrupt memory/stack.
2402	ABORT_DAT_WRITE_ITEM_FAIL	Data write item failed Subcodes: none Likely Causes: A low level write to the disc has failed. This can occur if the DOC has filled, or there is a problem with the DOC on the PC104. The PharLap OS provides the file handling, so any software error here would be located in the OS kernel for file access, and is very unlikely.

CP Error codes

2403	ABORT_DAT_FILE_OPEN_ERR_WRITE_ITEM	Data open file failed on Write Item Subcodes: none Likely Causes: There was a failed attempt to open a file on the disc for writing. This can occur if the DOC has filled or there is a problem with the DOC on the PC104. The PharLap OS provides the file handling, so any software error here would be located in the OS kernel for file access, and is very unlikely.
2404	ABORT_DAT_FILE_READ_BAD_POINTER	Bad pointer for read item. Subcodes: none Likely Causes: For every item read in the system, has a corresponding memory buffer. If the memory buffer is not valid (NULL pointer), we get this error code. This indicates an internal software failure.
2405	ABORT_DAT_FILE_READ_DATA_FAIL	Bad read of a BIN data file - missing or corrupt Subcodes: 1=Print Format data file. 2=Remote Settings data file. 3=Data Xfer Settings data file. 4=Date/Time Settings data file. 5=Language data file. 6=Test Sequence data file. 7=LCD Contrast data file. 8=Facility Name data file. Likely Causes: It is most likely that the file is not present or is not updated. When new software is loaded (or upgraded), files can be missing or out-of-date. With any new release that requires an update in data files, the system must be booted to the CAL DEFAULTS screen and the GSI USER/KEY DATA must be loaded. If this is not the source of the problem, one or more data files may have been corrupted due to a previous system crash (possible if a file was open for write and system crashes for any reason). It is also possible to be a DOC failure on the PC104. It is less likely a software problem with the file system, as all file I/O occurs through the PharLap OS.
2500	ABORT_INI_SECTION_NOT_FOUND	Ini file read - section not found Subcodes: none Likely Causes: The .INI file was found, but the section was not found. With any new release that requires an update in .INI file, the system must be booted to the CAL DEFAULTS screen and the GSI USER/KEY DATA must be loaded. If this is not the source of the problem, one or more data files may have been corrupted due to a previous system crash (possible if a file was open for write and system crashes for any reason). It is also possible to be a DOC failure on the PC104. It is less likely a software problem with the file system, as all file I/O occurs through the PharLap OS.
2502	ABORT_INI_FILE_NOT_FOUND	Ini file not found during read. Subcodes: none Likely Causes: The .INI file was not found for read access; it should be part of the initial TympStar installation. In this case one or more data files may have been corrupted due to a previous system crash (possible if a file was open for write and system crashes for any reason). It is also possible to be a DOC failure on the PC104. It is less likely a software problem with the file system, as all file I/O occurs through the PharLap OS.

CP Error codes

2503	ABORT_INI_WRITE_FILE_NOT_FOUND	Ini file not found during write. Subcodes: none Likely Causes: The .INI file was not found for read access; it should be part of the initial TympStar installation. In this case one or more data files may have been corrupted due to a previous system crash (possible if a file was open for write and system crashes for any reason). It is also possible to be a DOC failure on the PC104. It is less likely a software problem with the file system, as all file I/O occurs through the PharLap OS.
2504	ABORT_INI_WRITE_FILE_ERROR	Ini file write/append error. Subcodes: none Likely Causes: The .INI file was found but could not be written. It is possible the disc is full. In this case one or more data files may have been corrupted due to a previous system crash (possible if a file was open for write and system crashes for any reason). It is also possible to be a DOC failure on the PC104. It is less likely a software problem with the file system, as all file I/O occurs through the PharLap OS.
2600	ABORT_GFX_STR_IDX_OUTOFBOUNDS	GFX - string out of bounds array index or indices. Subcodes: none Likely Causes: Strings are always referenced in the system by a unique index number. If this number is out of bounds based on the current string list, this failure occurs. This indicates an internal software failure.
2700	ABORT_HW_PORT_WRITEBYTE	Attempt to read a 16-bit port with 8-bit routine. Subcodes: none Likely Causes: Ports are defined in a look-up table and all callers should know if their port is 8 bit or 16 bit. This failure indicates an internal software failure.
2701	ABORT_HW_PORT_READBYTE	Attempt to write a 16-bit port with 8-bit routine. Subcodes: none Likely Causes: Ports are defined in a look-up table and all callers should know if their port is 8 bit or 16 bit. This failure indicates an internal software failure.
2702	ABORT_HW_PORT16_WRITEBYTE	Attempt to read an 8-bit port with 16-bit routine. Subcodes: none Likely Causes: Ports are defined in a look-up table and all callers should know if their port is 8 bit or 16 bit. This failure indicates an internal software failure.
2703	ABORT_HW_PORT16_READBYTE	Attempt to write an 8-bit port with 16-bit routine. Subcodes: none Likely Causes: Ports are defined in a look-up table and all callers should know if their port is 8 bit or 16 bit. This failure indicates an internal software failure.
2800	ABORT_RTC_DATE_WRITE_ERR	Error attempting to update the RTC Subcodes: getlasterror() - see Windows documentation Likely Causes: The PharLap OS performs Real-Time-Clock read/writes. These are modeled after the Windows API calls. Any failures are associated with a faulty RTC on the PC104 or indicate an internal software failure.

CP Error codes

2801	ABORT_RTC_TIME_WRITE_ERR	Error attempting to update the RTC Subcodes: getlasterror() - see Windows documentation Likely Causes: The PharLap OS performs Real-Time-Clock read/writes. These are modeled after the Windows API calls. Any failures are associated with a faulty RTC on the PC104 or indicate an internal software failure.
2902	ABORT_HW_PRINTER_ADD_JOB_FAIL	Error attempting to add printer job. Out of Memory. Subcodes: none Likely Causes: Memory is allocated for the print buffers; when a print job is submitted the system checks to ensure that there is enough memory available for printing. Since the biggest possible canvas is pre-allocated, this would indicate an internal software failure.
2903	ABORT_HW_PRINTER_TIMEOUT	Error waiting for printer to be ready. BUSY stuck asserted. Subcodes: none Likely Causes: Print BUSY was stuck asserted. We know there are ESD problems that can cause this BUSY line to latch, so internal recovery is provided. If the BUSY line is still asserted after the recovery phase, we failsafe with this code. The most likely source of this problem is Printer board hardware (including CPLD), or possibly the printer firmware. It is also possible that there is a failure in the data/control line path from the printer board through the digital board to the printer port connector on the PC104.
2905	ABORT_HW_PRINTER_CANVAS_NULL	Printer canvas was NULL when submitting print job. Subcodes: none Likely Causes: After the print job is spooled, the print job is submitted and we check to ensure that the buffer passed was non-NULL. Since we pre-allocate our canvas buffers, this would indicate an internal software failure.
2906	ABORT_HW_PRINTER_ADD_JOB_FULL	Printer canvas was full when attempting to add a job. Subcodes: none Likely Causes: After the print job is spooled and submitted, the system checks to ensure that there is enough room in the printer buffers for this new canvas. Since we pre-allocate our canvas buffers to be large enough (and we expect that the printer should be able to take in bytes fast enough) this would indicate an internal software failure. It is possible that the printer firmware is taking in bytes slower than expected (but not slow enough to assert the ABORT_HW_PRINER_TIMEOUT failsafe).
2907	ABORT_HW_KBD_BAD_TEXT_FIELD_IDX	Bad text field index (patient name, id, etc) Subcodes: none Likely Causes: The CP software maintains an internal index for which text field is currently active (Patient name, ID, Tester) and if that index ever gets out of range then this failsafe occurs. Since the software directly controls this index, this code would indicate an internal software failure.
3000	ABORT_RT_RAM_TEST_FAIL	Regulatory Testing - RAM Test Failure. Subcodes: cData - data byte that failed R/W. Likely Causes: PC104 SRAM or other PC104 failure.
3001	ABORT_RT_SEREE_TEST_FAIL	Serial EEPROM failure Subcodes: read data byte Likely Causes: Probe EE faulty or a problem with the data/control path from probe back to the digital board.

CP Error codes

3100	ABORT_DIAG_SP_NOT_RESPONDING	SP Not responding during entry to DIAG mode. Subcodes: none Likely Cause: When the system first enters the Diagnostics Mode, the DPRAM is enabled and the SP is taken out of reset (i.e. initialized). The unit can detect the SP state of being initialized since the SP writes to key DPRAM locations that are monitored. If the SP does not initialize, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
3200	ABORT_CAL_SETUP_SP_NOT_RESPONDING	SP Not responding during entry to CAL mode. Subcodes: none Likely Cause: When the system is first enters the Calibration Mode, the DPRAM is enabled and the SP is taken out of reset (i.e. initialized). The unit can detect the SP state of being initialized since the SP writes to key DPRAM locations that are monitored. If the SP does not initialize, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
3201	ABORT_CAL_PROBE_SPL_SP_NOT_RESPONDING	SP Not responding during entry to CAL PROBE SPL mode. Subcodes: none Likely Cause: During PROBE SPL calibration, the SP is asked to perform the actual calibration. If the SP does not respond to the request, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
3202	ABORT_CAL_SPL_SP_NOT_RESPONDING	SP Not responding during entry to CAL Contra/IPSI SPL mode. Subcodes: none Likely Cause: During CONTRA/IPSI SPL calibration, the SP is asked to perform the actual calibration. If the SP does not respond to the request, there could be an internal SP problem or the hardware path between the SP and CP could be faulty.
3300	ABORT_HW_SEREE_READ_OFFSET_OOR	Specified address to read from SEREE invalid. Subcodes: Offset into SEREE that was read. Likely Causes: All SEREE read/writes are bounds-checked to ensure that the units are actually reading and writing to the SEREE and not outside the valid 8K range. This code would most likely indicate an internal software failure.
3301	ABORT_HW_SEREE_WRITE_OFFSET_OOR	Specified address to write to SEREE invalid. Subcodes: Offset into SEREE that was written. Likely Causes: All SEREE read/writes are bounds-checked to ensure that the units are actually reading and writing to the SEREE and not outside the valid 8K range. This code would most likely indicate an internal software failure.
3302	ABORT_HW_SEREE_READ_INTEGRITY	SEREE Readback failed integrity check Subcodes: hamming code report. Likely Causes: All SEREE read/writes are integrity-checked by using a hamming code and reserving half the EE (4K) for this hamming check. Each byte has a corresponding hamming byte to ensure it is valid. A failure here might indicate that the probe EE has not been properly formatted for use with the TympStar. It can also be a failure with the EE itself, or with the data/control lines that run from the EE on the probe to the Digital board.

CP Error codes

3303	ABORT_HW_SEREE_WAIT_FOR_ACK	SEREE never acknowledged request for write Subcodes: none Likely Causes: As each byte is shifted out to the EE, the CP software checks to ensure that the EE is ready to accept a write request. The most likely cause for this would be a faulty EE or a problem with the data/control lines that run from the EE on the probe to the Digital board. Noise on these lines would also be a problem.
3304	ABORT_HW_SEREE_NACK	EE NACKed the previous byte write. Subcodes: none Likely Causes: As each byte is shifted out to the EE, the CP software checks the ACK line to ensure that writes are proceeding correctly. The most likely cause for this would be a faulty EE, or problems with the data/control lines that run from the EE on the probe to the Digital board. Noise on these lines would also be a problem.
3306	ABORT_HW_SEREE_PROBE_VER_INCOMPAT	Probe EE was incompatible version - could not upgrade. Subcodes: current probe ver # Likely Causes: An unknown probe version has been attached to the TympStar. For example, a future release 3 probe attached to a release 2 system. The release 2 system cannot upgrade this format probe. A probe with bad data could result in this failsafe, but only if it managed to get through the probe-present check and hamming code to ensure that the integrity of the EE was good.
3400	ABORT_KEY_NEWSK_SETOPMODE_SEREE	Fetch of Serial EE shadow took too long Subcodes: none Likely Causes: A maximum time of 30 seconds is put on the probe EE shadow read. This code can indicate a large number of retries with the SEREE read and can indicate a problem with the EE or the data/control path back to the CP (including noise that may be causing retried reads). Less likely is a software problem that sees the shadow read task failing and this would indicate an internal software failure.

SP Error codes

Code	Short Description	Description
0002	System RAM Test Failure	System RAM is checked for integrity at reset. Subcodes: Specific address that failed. Likely Causes: Shorted data line, open data line, intermittent address/control line, defective component at U30.
0003	EPROM Checksum Mismatch	The EPROM is checksummed at reset; this checksum is compared to the one that is stored on the EPROM. Subcodes: None. Likely Causes: Corrupt EPROM at U28.
0005	Divide by Zero	If processor is instructed to divide by zero, this exception is generated. Subcodes: None. Likely Causes: Corrupt calibration data in probe; noise during calibration.
0007	Non-Maskable Interrupt	The processor received an interrupt from an unconnected source. Subcodes: None. Likely Causes: Software error ,failed processor; U26.46 intermittent or shorted high.
0009	Overflow Exception	Register overflowed as a result of a math instruction. Subcodes: None. Likely Causes: Software error.
0010	Array Bounds Exception	If an array were indexed with an out of bounds value, the processor would be instructed to generate this exception. Subcodes: None. Likely Causes: Software error.
0011	Invalid Opcode	Processor will generate this failure if it attempts to process an invalid instruction. Subcodes: None. Likely Causes: Software error.
0012	Escape Instruction Interrupt	Processor will generate this failure if the ESC instruction is executed. The software never instructs this in normal operation. Subcodes: None. Likely Causes: Software error.
0013	Undefined Interrupt	Software interrupt that is not designated for any use. Subcodes: None. Likely Causes: Software error.
0014	DMA Interrupt	Processor generates this interrupt when a DMA operation completes; however, DMA is not used in the TympStar, so this should never occur. Subcodes: None. Likely Causes: Software error.
0015	Unused Timer Interrupt	Generated if an unused timer generates an interrupt. Subcodes: None. Likely Causes: Software error.
0016	Invalid Real-Imaginary Buffer Index During Get	The software ensures that the index used to retrieve real-imaginary data from its memory array is bounds checked. Subcodes: Index into buffer. Likely Causes: Software error.
0018	Invalid Pseudo-Code Template Number	Signal processor checks the value of the pseudo-code template to execute when the Control processor sends it. Subcodes: Template number requested. Likely Causes: Control processor software error.
0019	Invalid Command Number	Signal processor checks the value of the command issued by the Control processor. Subcodes: Command number issued. Likely Causes: Control processor software error.

SP Error codes

0020	Self Calibration Failed	Signal processor was unable to find a suitable counter value to produce the target frequency during self-cal procedure. After SP version 6.0, this error code is unused (self-cal no longer exists). Subcodes: Target frequency code (0=226, 1=678, 2=1000, 3-38 = 250-1000 in 50Hz steps) Likely Causes: Probe tone oscillator circuit; probe tone oscillator clock.
0023	Invalid Mic Level During Y Calibration	Signal processor checks to ensure that the mic VCA level has not been set too high or too low to accomplish calibration. Subcodes: None. Likely Causes: Probe mic circuit.
0024	Invalid Pseudo-Code Instruction	Signal processor checks to ensure that the requested pseudo-code instruction is valid while processing a pseudo-code template. Subcodes: Invalid code. Likely Causes: Software error.
0025	Invalid Pseudo-Code Math Code	Signal processor checks to ensure that the requested pseudo-code math operation is valid while processing a pseudo-code template. Subcodes: Invalid math code. Likely Causes: Software error.
0027	Rotation Error – Theta 2 > Theta1	Signal processor ensures that Theta2 is not greater than Theta1 during 2.0cc YBG calibration. Subcodes: Filter mode that failed check (0 = Low Pass Multiplexed, 1 = Low Pass Steady, 2 = BandPass, 3 = Swept) Likely Causes: Wrong cavity volume used during calibration.
0035	DPRAM Integrity Failure	Signal processor performs a write/read test of DPRAM at reset. Subcodes: Address of failure. Likely Causes: Shorted data lines, open data lines, intermittent address lines, defective component at U1.
0036	Compliance Calculation Coefficent Out of Range	Signal processor checks the calculated value of all complaince calculation coefficients as they are generated from calibration data. If this value exceeds 65535, it is deemed bad data and this exception is generated. Subcodes: low byte (0^{th} and 1^{st} nibble) indicates SPL (0 - 27 = 67dB – 93dB); 2^{nd} nibble indicates filter mode (0 = Low Pass Multiplexed, 1 = Low Pass Steady, 2 = BandPass, 3 = Swept); 3^{rd} nibble indicates frequency (0 = 226Hz, 2 = 678Hz, 2 = 1000Hz). Likely Causes: Bad calibration data in probe.
0037	Scaled Compliance Coefficent Out of Range	Signal processor checks the calculated value of all compliance calculation coefficients as they are scaled during 2.0cc compliance calibration. If this value exceeds 65535, it is deemed bad data and this exception is generated. Subcodes: low byte (0^{th} and 1^{st} nibble) indicates SPL (0 - 27 = 67dB – 93dB); 2^{nd} nibble indicates filter mode (0 = Low Pass Multiplexed, 1 = Low Pass Steady, 2 = BandPass, 3 = Swept); 3^{rd} nibble indicates frequency (0 = 226Hz, 1 = 678Hz, 2 = 1000Hz). Likely Causes: Bad calibration data in probe; Noise during calibration.
0040	DFT Limit Too Small	While performing 2.0cc compliance calibration, the signal processor ensures that the measured compliance at a nominal gain setting allows for enough span in DFT calculation. Subcodes: Out-of-range nominal DFT base. Likely Causes: Clogged probe; mic circuit; filter circuit; wrong cavity size used; bad probe SPL calibration data.

SP Error codes

0041	DFT Limit Too Big	While performing 2.0cc compliance calibration, the signal processor ensures that the measured compliance at a nominal gain setting allows for enough span in DFT calculation. Subcodes: Out-of-range nominal DFT base. Likely Causes: Clogged probe; mic circuit; filter circuit; wrong cavity size used; bad probe SPL calibration data.
0042	Invalid Speaker Level Input to Mux	Signal processor checks to ensure that when the probe speaker level is to be written to EEPROM during pseudo-code execution, that the probe speaker mux is set to the corresponding position. Subcodes: Invalid position. Likely Causes: Software error.
0043	Probe VCA DAC Level Out of Range	Signal processor checks to ensure that when the probe speaker level is to be written to EEPROM when commanded by the Control Processor (during Probe SPL calibration), that the value is within a the valid range of 0 to 255 DAC counts. Subcodes: The invalid level. Likely Causes: Clogged probe tube; probe tone oscillator; probe tone VCA.

Error Messages

Error messages are text and are generated by the Control Processor. The following messages may occur either as the result of an improper selection made by the operator or by a fault internal to the GSI TympStar:

ERROR INVALID SELECTION
An unlabeled softkey was pressed.

ERROR INVALID SELECTIONWHILE CALIBRATINGCOMPLIANCE
The altitude up/down keys were pressed, or the Y calibration screen attempted printing while calibrating the compliance.

INVALID INTENSITY LIMIT REACHED
A stimulus level (dB HL) was selected that was either outside the legally set limits or would require an unattainable attenuator setting to produce the stimulus level.

NOTE PROBLEM STORING DATA- CONTACT SERVICE
If this message is reoccurring, the digital board is most likely at fault. A Control Processor HELP 1052 message is also likely to occur.

ERROR INVALID SELECTION DURING CAL MODE
The key pressed is not valid while in the calibration mode.

NOTE SITE ALTITUDE DEFAULTED TO 0 - RE-ENTER IFNECESSARY
If this message occurs, the altitude cal procedure should be attempted.

ERROR INVALID SELECTION UNTILA CAL MODE SELECTED
The key pressed is not valid in the current calibration mode, which is indicated by the current calibration screen displayed.

ERROR INVALID SELECTION DURING IPSI/CONTRA SPL CAL
The key pressed is not valid while in IPSI/CONTRA SPL calibration mode.

ERROR INVALID SELECTION DURING PROBE SPL CAL
The key pressed is not valid while in the probe SPL calibration mode.

ERROR INVALID SELECTION DURING COMPLIANCE CAL
The key pressed is not valid while in the compliance calibration mode.

ERROR INVALID SELECTION DURING PRESSURE CAL
The key pressed is not valid while in the pressure calibration mode.

INVALID OUTPUT VOLTAGE LIMIT REACHED
An attenuator level was selected in the calibration mode using the set SPL up/down or intensity up/down keys for a stimulus that is outside of the valid attenuator limits.

INVALID SELECTION CUSTOM REFERENCE THRESHOLD MODE NOT SELECTED
An attempt was made to modify the SPL limits using the set SPL up/down softkeys with the custom reference threshold mode not selected.

WARNING INSUFFICIENT WARM UPTIME—UNIT MUST BE ON 10 MINUTES
The unit has not sufficiently warmed up (10 minutes) in the calibration mode. The calibration may be performed, but the accuracy is not guaranteed.

INVALID SPL LIMIT REACHED
An attempt was made to modify the set SPL value to more than ±10 dB HL away from the GSI set SPL value for that stimulus.

NR <>
Screening reflex test result indicating that the test was stopped for that stimulus with no reflex detected due to an attenuator limit error when setting the attenuator for the intensity being tested.

NT <>
Screening reflex test result indicating that no test was performed for that stimulus due to an attenuator limit error when setting the attenuator for the intensity being tested.

NOTE GSI DEFAULTS USED - REPROGRAM
Try reprogramming the user key data.

NOTE TEST NOTAVAILABLE - CONTACT SERVICE
Calibration should be performed on the IPSI and CONTRA transducers.

NOTE REFLEX DECAY NOTAVAILABLE - CONTACT SERVICE
Calibration should be performed on the IPSI and CONTRA transducers.

ERROR INVALID SELECTION DURING DIAGNOSTIC MODE
The key pressed is not valid while in the diagnostic mode.

PROBE TONE LEVEL CHANGED - PERFORM Y CALIBRATION
The probe tone SPL calibration has been changed requiring a recalibration of the compliance.

ALERT PUMP LIMIT REACHED - RESELECT SOFTKEY
The pump ran out of stroke trying to reach or maintain a specified pressure because of a leak in the pressure system. The test can be restarted by reselecting the appropriate softkey.

ALERT PUMP OVER PRESSURIZED - RESELECT SOFTKEY
The pump pressurized beyond the acceptable pressure range. This condition is detected by software or an over-pressure valve tripping. The test may be restarted by reselecting the appropriate softkey.

ALERT PUMP LIMIT REACHED
Enter the Pressure Cal portion of the CAL Mode. Select the -600/400 softkey and perform the Leak Rate test. If leak is excessive, enter the Diagnostic section of the Pressure Cal Mode.

ERROR INVALID SELECTION - PROBE TONE NOT SELECTED
The Present Bar was pressed to turn on the probe tone without a probe tone frequency being selected during the probe tone Cal Mode.

ALERT ALTITUDE LIMIT REACHED
An altitude was selected beyond the valid range.

ALERT HIGH INTENSITYSELECTED
A stimulus intensity level above 100 dB HL has been selected.

ALERT VALVE NOT TRIPPED -ADJUST VALVE LIMIT SETTING
Enter the Pressure Cal portion of the CALMode, select the Verify Cal softkey, then the Safety Valve softkey and perform the calibration.

NOTE CANNOT START TEST - PERFORM ALTITUDE CAL - CONTACT SERVICE
Perform an altitude calibration.

ALERT PROBE MUST BE IN A CAVITY BEFORE PRESSING DATA TRANSFER
The probe was detected out of the cavity while attempting to calibrate the compliance.

LCD problem symptoms and probable causes

Lcd completely blank, but probe led's blinking
Check the contrast adjustment potentiometer.
Check LCD backlight inverter operation.

Lcd completely blank and probe led's off
Check the integrity of power supply voltages at each board, CPU supply (+5 VDC) being the most critical. Also check the contrast adjustment potentiometer.

Probe problem symptoms and probable causes

Amber led solidly on for any test attempt
Indicates an occlusion. Remove the probe tip and clean the metal tubes with the supplied cleaning kit.

Amber led blinking for any test attempt
Indicates an air pressure leak. If after trying several seal attempts in the ear it does not clear, try running in a hardwall cavity. If leak persists, check the pump function in the pressure cal portion of the Cal Mode. Also check the probe tip tubing very carefully for any splits or slices.

Tymp peaks appear shifted in the pressure domain
Possible pressure cal error or restriction in the air pressure feed tubing. Check the pressure cal in the Cal Mode. Restrictions can be identified by large overshoot numbers (> 50 daPa) in the set -600/400 Mode.

Reflex Artifact In The Hardwall Cavity
Check for pinched probe tubes inside the probe box.
Replace the probe or check the stimulus cal levels.

Compliance or Y, B or G calibration shift
1) Tubing length from the probe box to the probe tip has a direct effect on calibration. If the length is altered, the calibration must be performed.

2) Perform an Altitude Calibration. If the calibration error persists, perform completeYcal orYBG cal in the Calibration Mode. If calibration is not possible, it will be identified by HELP messages.

Cavity or ear read
7.0 @ 226 Hz
21.0 @ 678 Hz
31.0 @ 1 kHz
The probe mic. or speaker tube is totally occluded. Clean the probe tip.

Pump problem symptoms and probable causes

Leak messages indicated when probe is in the hardwall cavity
1) Go to the diagnostic portion of Pressure Cal Mode. Pressurize the system and pinch the tubing at various points to isolate the source of the leak.
2) Check the accuracy of the pressure calibration, overshoot, linearity, etc., in the Pressure Cal Mode.

Overpressure safety switches vent pressures during normal operation
1) Perform Safety Valve calibration.

2) With the unit power OFF, measure for 0 Ohms on safety switch connectors that are connected to Digital board. If a switch measures open, it is the cause of the fault.

ALERT PRESSURE SYSTEM ERROR - POSSIBLE LEAK
Message occurs at power up or during any test attempt
Check pump photo eye for proper function.

Printer problem symptoms and probable causes

Blank areas in the printout
1) Possible dirty print head. Run ordinary typewriter bond paper through the printer. Its surface is abrasive enough to clean the head.

ALERT PRINTER ERROR, CHECK PAPER OR RELEASE LEVER
Message repeatedly occurs although paper and release lever are positioned properly
1) A photo eye and a microswitch in the printer assembly detect these situations. Check all connections from the digital board to the printer board for open or intermittent connections.

2) Check cables between the digital board and printer board for intermittent connections. Check the the printer to printer board ribbon cable for intermittent connections.

Hardware Diagnostic mode

The Hardware Diagnostic Mode is entered by setting the Calibraion Options DIP switch 6 to ON and entering the Cal Mode. Refer to Chapter 4: Calibration for detailed instructions regarding the Cal Mode and Diagnostic Mode. The Hard-ware Diagnostic Mode gives you complete control of the hardware circuitry in the GSI TympStar. The LCD will display selection possibilities that are available for setting the various circuits to desired known states to facilitate troubleshooting. During normal operation, the control process and signal processor control the circuitry, and in most cases they are not set in steady state conditions; therefore troubleshooting is difficult.

All the blocks of circuitry that can be selected and set will be described in the following paragraphs. Also, states and conditions that exist when default data is loaded into memory and operating parameters are chosen (i.e., 1 kHz into a 2 cc cavity, etc.) will be indicated.

Functional description

The following text describes the circuit functions that can be controlled by the Diagnostic Mode.

NOTE

NOTE:
GSI will make available instructions, schematic diagrams and other system drawings as it deems appropriate to be repaired in the field.

Pressure A/D MUX

The Pressure Multiplexer is a CMOS analog switch located on Analog Schematic. This multiplexer circuit's main function during normal mode operations, is to route the probe pressure transducer signal or manual pressure pot signal to the control processor A/D converter (digital board schematic). There are six additional signals connected to it, which during initialization are monitored as integrity checks to provide diagnostic information. These additional signals are as follows:

1) Ipsi power amplifier output (Analog Schematic)
2) Contra power amplifier output (Analog Schematic)
3) Mic. level control DAC (Level Control Schematic)
4) Probe tone level control DAC (Level Control Schematic)
5) Ipsi level control DAC (Level Control Schematic)
6) Contra level control DAC (Level Control Schematic)

The various signals can be routed to the Control Processor A/D by selecting the MUX INPUTS softkey, then the PRESSURE MUX softkey.

Mic. MUX

The Microphone Multiplexer is a CMOS analog switch located on the Analog Schematic. This multiplexer circuit's main function, during normal mode operation, is to route the filtered probe microphone signal to the Signal Processor A/D converter (digital board Schematic). There are three additional signals connected to it, which during initialization, are monitored as integrity checks to provide diagnostic information. These additional signals are as follows:

1) Probe Speaker Level 1 (Analog Schematic)
2) Probe Speaker Level 2 (Analog Schematic)
3) Microphone Circuit Ground (Analog Schematic)

NOTE
Routing the probe speaker drive levels with this multiplexer enables you to completely bypass the probe assembly when checking Y/B/G measurement circuitry integrity.

The various signals can be routed to the signal processor A/D by selecting the MUX INPUTS softkey, then the MIC MUX softkey.

Probe tone and filter mode

The various probe tone frequencies can be selected and turned ON or OFF by selecting the PROBE/FILTER softkey. When this softkey is selected, additional softkeys are displayed that allow you to select the microphone filter type, the probe tone frequency and the probe tone signal for ON or OFF. These selections enable you to troubleshoot the probe tone oscillator, probe tone channel, probe assembly and microphone filter circuitry.

DAC levels

The level control DACs (Digital to Analog Converters) can be selected and programmed in this mode (Refer to the Level Control Schematic or Level Control/Stim Schematic). The DACs can be accessed by pressing the DAC LEVEL softkey, then the desired DAC. When the desired DAC is selected, you can increment or decrement the DAC output by one or ten bits at a time. The DACs control VCAs (Voltage Controlled Amplifiers) on the Analog board. When the DACs are set to 0, the VCAs are at full gain. With the DACs set to 255 the VCAs are at minimum gain (full attenuation).

Routing

The Ipsi and Contra channel signals can be routed to either the Ipsi or Contra transducer in this mode. This mode controls the Ipsi and Contra Mixer circuits (Analog Switches) shown on the Analog Schematic. Access to this mode is gained by selecting the ROUTING softkey. When Routing is selected, four additional softkeys will be displayed:

I-I: Routes the Ipsi channel to the Ipsi transducer
I-C: Routes the Ipsi channel to the Contra transducer
C-I: Routes the Contra channel to the Ipsi transducer
C-C: Routes the Contra channel to the Contra transducer

IPSI/CONTRA and OSC l/OSC 2

Oscillator 1 (Analog Schematic) and Oscillator 2 can be programmed and routed in this mode. Also the Ipsi and Contra channels can be turned on or off in this mode. With this combination of oscillator programming/routing and channel control, either oscillator can be routed to either channel and the desired stimulus can be selected. This mode, in conjunction with the Routing Mode, enables analysis of all the possible mixing, routing and available stimulus selections. The channels are turned on or off with the IPSI ON/OFF and CONTRA ON/OFF softkeys. The selection of oscillator and stimulus to either channel is accomplished using the IPSI SOURCE and CONTRA SOURCE softkeys.

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