TEMPTRONIC CORPORATION

TP04100A

ThermoStream®

Interface & Applications Manual

Revision A

Scope of Manual

This manual contains procedures for **general and advanced operation, assembly, interfacing, interconnecting, preventive maintenance** and **remote operation** parameters.

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Notice

Patents have been granted and/or patent applications are pending or are in process of preparation on all Temptronic Corporation developments.

The material in this manual is for informational purposes only and is subject to change without notice.

Temptronic Corporation assumes no responsibility for any errors that may appear in this manual.

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DOCUMENT CONTROL		
Revision	Date of Change	Pages Changed
Rev B	08/25/1999	Page 2-14: added Step 9, Locking Collar; Page 2-15: inserted Drawing 13996B, shows Locking Collar Page iv: added Document Control table

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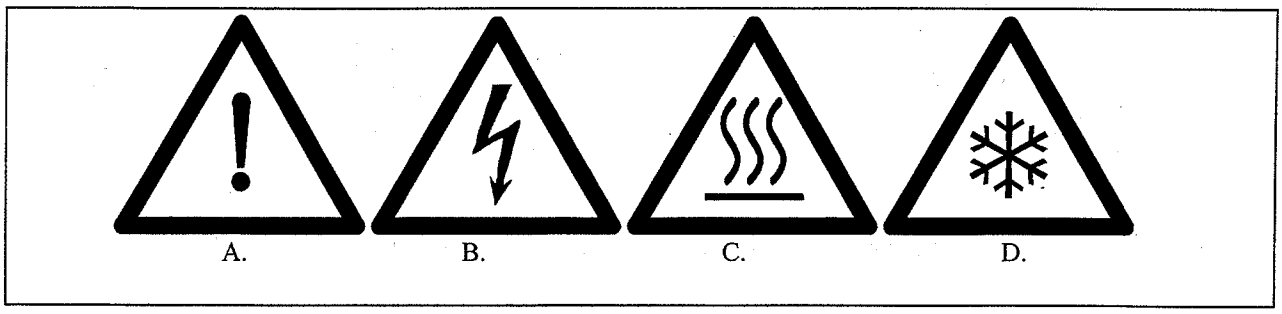
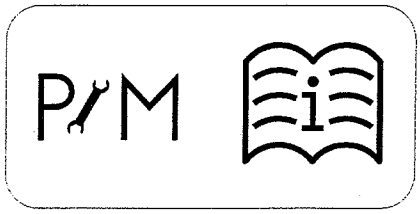
Use this space for system user/operator sketches

SAFETY PRECAUTIONS

A. Safety Precautions For Operating Personnel



Symbols: A. Caution, B. High Voltage, C. Hot Surface, D. Cold Surface



Preventive Maintenance Symbol

WARNING 1: Operating personnel should perform only the procedures described and recommended in this manual. Only qualified service personnel familiar with the electrical shock hazards present inside the equipment should perform disassembly or corrective maintenance of the equipment.

WARNING 2: To avoid shock hazard, the equipment must be grounded with an adequate earth ground in accordance with local electrical codes.

WARNING 3: The locations of potentially dangerous voltages and other hazards such as hot surfaces are identified and labeled on the equipment. Be careful to observe these warnings when installing, operating, maintaining, or servicing the equipment. Observe all warnings given in this manual.

WARNING 4: Make sure to turn off the ~ (ac) line power and the compressed air to the TP04100A System before attempting to access or service the air filters. Do not perform this service unless qualified to do so.

WARNING 5: Exposed surfaces in and around the output nozzle and thermal cap of the system can operate at extremely hot and cold temperatures which are unsafe to touch.

WARNING 6: The parts contained inside the thermal wand operate at extremely hot and cold temperatures unsafe to touch. Do not perform any maintenance inside the thermal wand assembly until the system is turned off and disconnected. Wait until thermal wand parts have reached a safe and stable temperature near ambient.

WARNING 7: When connecting thermocouple sensors to the Device Under Test (DUT), electrically isolate the sensors to protect operators from contact with any DUT site hazardous voltages.

CAUTION 1: Some of the packing materials in the TP04100A shipment may be a source for Electrostatic Discharge (ESD) potential. Do not unpack in the vicinity of ESD sensitive components.

CAUTION 2: Observe the precautions given on the equipment and within this manual to prevent damage to the equipment.

CAUTION 3: Before connecting the TP04100A to its electrical source, check that the ~ (ac) voltage and frequency to be supplied to the TP04100A are correct for those listed on its data plate (located on the rear panel of the controller cabinet).

CAUTION 4: Always hold the thermal wand firmly while positioning or re-positioning the stand arm.

CAUTION 5: Use proper handling and packaging procedures for ESD sensitive circuit boards. Assume that all circuit boards are the ESD sensitive type.

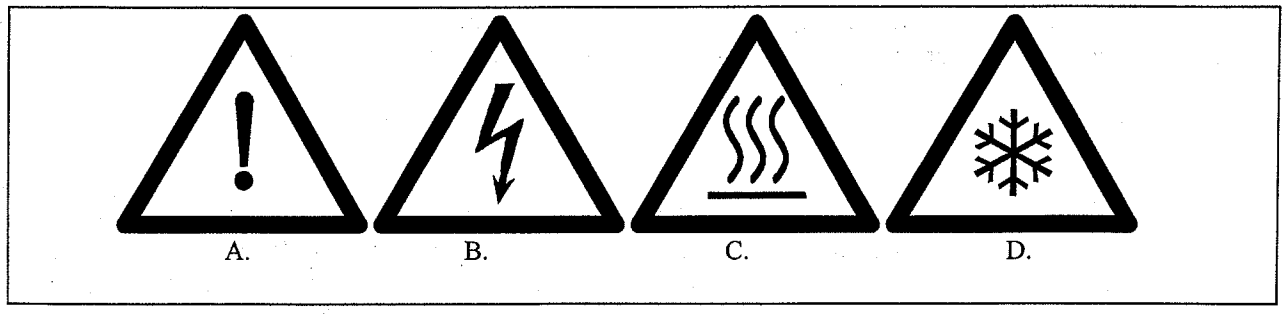
CAUTION 6: Unauthorized personnel should not remove from the equipment those panels that are provided for protection and/or cooling and/or require a tool to remove.

CAUTION 7: Use suitable Clean Dry Air (CDA) compressed air supply for the TP04100A system a) to prevent premature fouling of the filter/regulator assembly provided with the system, b) to prevent ice forming within the cooling module and possibly reducing or obstructing output air flow. Improper air supply quality can lead to possible damage to system internal operating components.

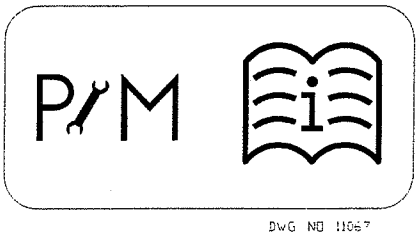
CAUTION 8: Properly install, use and maintain the filter/regulator assembly provided with the TP04100A system. Doing so prevents moisture and/or compressor oils from being introduced into operating components of the system. If left unchecked, this can cause damage to the system not covered under warranty.

CAUTION 9: The two thermal runaway Safety sensors (SF1 and SF2), located on the rear panel, must remain plugged in for normal operation. If SF2 is not plugged in when the system is powered On, then an internal fuse must be replaced by qualified service personnel before normal operation can resume. Only qualified service personnel should disconnect SF1 and/or SF2.

B. CONSIGNES DE SÉCURITÉ POUR LE PERSONNEL EXPLOITANT



Symboles: A. Attention, B. Haute tension, C. Surface chaude, D. Surface froide



Symbole Attention, Maintenance Préventive

AVERTISSEMENT 1 : Le personnel de service ne doit effectuer que les opérations décrites et recommandées dans ce manuel. Seul un personnel de service qualifié, familiarisé avec les risques d'électrocution présents à l'intérieur de l'équipement est habilité à procéder au démontage ou à la maintenance corrective de l'équipement.

AVERTISSEMENT 2 : Pour éviter tout risque d'électrocution, l'équipement doit être mis à la terre à l'aide d'une prise de terre adéquate conformément aux codes électriques locaux.

AVERTISSEMENT 3 : Les endroits présentant des tensions potentiellement dangereuses et autres risques tels que les surfaces brûlantes sont identifiés sur l'équipement. Veiller à respecter ces mises en garde lors de l'installation, de l'utilisation, de la maintenance ou de l'entretien. Respecter tous les avertissements contenus dans ce manuel.

AVERTISSEMENT 4 : Veiller à couper l'alimentation électrique (c.a.) et l'arrivée d'air comprimé du système TP04100A avant d'essayer d'accéder aux filtres à air ou d'effectuer leur entretien. Ces entretiens doivent être exclusivement confiés à un personnel qualifié.

AVERTISSEMENT 5 : Les surfaces exposées à l'intérieur et autour de la buse de sortie et du capuchon thermique peuvent atteindre des températures de fonctionnement extrêmement élevées ou basses, dangereuses au toucher.

AVERTISSEMENT 6 : Les pièces internes de l'élément thermique peuvent atteindre des températures de fonctionnement extrêmement élevées ou basses, dangereuses au toucher. N'effectuer aucun entretien à l'intérieur de l'ensemble d'élément thermique tant que le système n'a pas été mis hors tension et débranché. Attendre que les pièces de l'élément thermique aient atteint une température stable et sans danger, proche de la température ambiante.

AVERTISSEMENT 7 : Lors de la connection des détecteurs à thermocouple au dispositif en cours d'essai (DUT), isoler électriquement les détecteurs afin de protéger les opérateurs de tout contact avec des tensions dangereuses d'un site DUT.

ATTENTION 1 : Certains matériaux d'emballage utilisés pour l'expédition du TP04100A peuvent être une source de décharge électrostatique. Ne pas déballer à proximité d'appareils sensibles aux décharges électrostatiques.

ATTENTION 2 : Respecter les mises en garde apposées sur l'équipement et contenues dans ce manuel pour éviter des dommages à l'équipement.

ATTENTION 3 : Avant de brancher le TP04100A sur sa source d'alimentation électrique, vérifier que la tension (c.a.) et la fréquence correspondent aux valeurs indiquées sur la plaque signalétique (se trouvant sur le panneau arrière du boîtier du contrôleur).

ATTENTION 4 : Toujours maintenir l'élément thermique fermement lors du positionnement ou du repositionnement du bras de stand.

ATTENTION 5 : Utiliser les procédures de manipulation et d'emballage adéquates pour les cartes de circuit imprimé sensibles aux décharges électrostatiques. Présumer que toutes le cartes de circuit imprimé sont sensibles à l'électricité statique.

ATTENTION 6 : Les panneaux conçus pour la protection et/ou le refroidissement et/ou exigeant l'usage d'un outil pour être déposés ne doivent pas être retirés par un personnel non autorisé.

ATTENTION 7 : Utiliser une alimentation d'air comprimé sec et propre (CDA) pour le système TP04100A a) afin d'éviter l'encrassement prématuré des filtres/de l'ensemble régulateur fournis avec le système, b) pour empêcher la formation de givre à l'intérieur du module de refroidissement et la réduction ou l'obstruction éventuelle du débit d'air de sortie. Une qualité inappropriée d'alimentation d'air peut entraîner un endommagement éventuel des composants internes de fonctionnement du système.

ATTENTION 8 : Installer, utiliser et entretenir correctement l'ensemble de filtre/régulateur fourni avec le système TP04100A pour empêcher la pénétration de l'humidité et/ou des huiles du compresseur dans les composants actifs du système. Si ces précautions ne sont pas prises, le système peut subir des dommages qui ne sont pas couverts par la garantie.

ATTENTION 9 : Les deux détecteurs de sécurité en cas de fuite thermique (SF1 et SF2), situés sur le panneau arrière, doivent rester branchés pour assurer un fonctionnement normal. Si SF2 n'est pas branché lors de la mise en marche du système, un fusible interne doit être remplacé par du personnel d'entretien qualifié pour retrouver un fonctionnement normal. Seul du personnel d'entretien qualifié est autorisé à déconnecter SF1 et/ou SF2.

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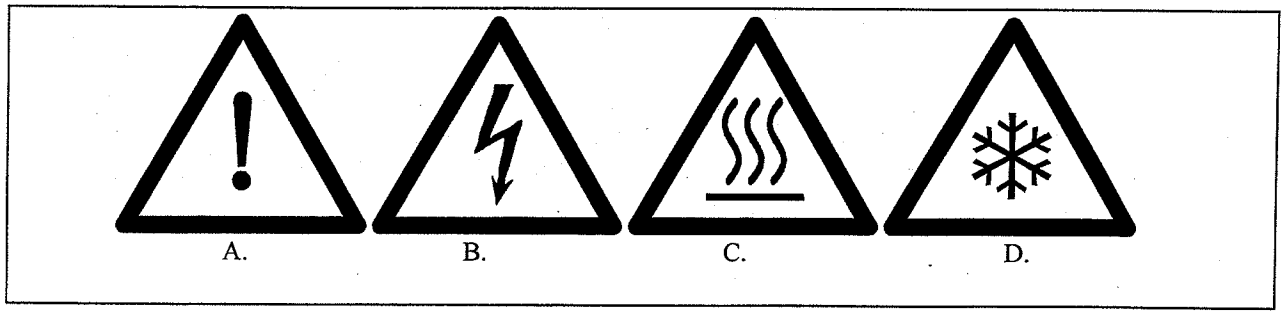
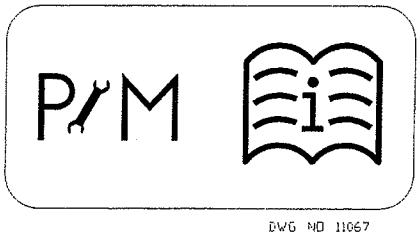
C. RHEITSHINWEISE FÜR BEDIENUNGSPERSONAL



Symbole: A. Vorsicht, B. Hochspannung, C. Heiße Oberfläche, D. Kalte Oberfläche



Vorbeugende Wartung

WARNUNG 1: Das Bedienpersonal darf nur die in diesem Handbuch beschriebenen und empfohlenen Verfahren anwenden. Eine Demontage der Einrichtung bzw. korrektive Wartungsmaßnahmen an ihr sollte(n) nur von qualifiziertem Servicepersonal ausgeführt werden, das mit den elektrischen Gefährdungen innerhalb der Einrichtung vertraut ist.

WARNUNG 2: Um eine Gefährdung durch elektrische Schläge zu vermeiden, muß die Einrichtung entsprechend den lokalen elektrischen Vorschriften über eine adäquate Masseleitung geerdet sein.

WARNUNG 3: Die Orte potentiell gefährlicher Spannungen und anderer Gefährdungen, z.B. heißer Oberflächen, sind an der Einrichtung mit Etiketten gekennzeichnet. Beim Installieren, Bedienen, Warten bzw. bei Servicearbeiten an der Einrichtung sind diese Warnungen sorgfältig zu befolgen. Es sind alle in diesem Handbuch aufgeführten Warnungen zu beachten!

WARNUNG 4: Es ist zu gewährleisten, daß Netzspannung und Druckluft zum System TP04100A abgeschaltet sind, bevor Sie die Luftfilter berühren bzw. Servicearbeiten an ihnen ausführen. Servicearbeiten dürfen ohne diesbezügliche Qualifikation nicht ausgeführt werden.

WARNUNG 5: Zugängliche Oberflächen von Ausgangsdüse und Wärmehaube des Systems können extrem heiße und kalte Temperaturen aufweisen, die eine Berührung nicht zulassen.

WARNUNG 6: Auch Teile innerhalb der Wärmewand können extrem heiße bzw. kalte Temperaturen aufweisen, die eine Berührung nicht zulassen. In der Wärmewand dürfen keine Wartungsarbeiten durchgeführt werden, bevor das System abgeschaltet und getrennt ist. Warten Sie, bis die Teile der Wärmewand eine sichere und stabile Temperatur nahe der Umgebungstemperatur erreicht haben.

WARNUNG 7: Beim Anschließen der Thermoelement-Sensoren an die getestete Vorrichtung (DUT) müssen die Sensoren elektrisch isoliert werden, damit das Personal vor Kontakt mit gefährlichen Spannungen am DUT-Ort geschützt ist.

VORSICHT 1: Einige Verpackungswerkstoffe des TP04100A können eine Quelle elektrostatischer Aufladung sein. Entpacken Sie nicht in der Nähe elektrostatisch empfindlicher Bauteile.

VORSICHT 2: Beachten Sie die in der Einrichtung selbst und in diesem Handbuch angegebenen Schutzmaßnahmen, um die Einrichtung vor Beschädigung zu bewahren.

VORSICHT 3: Vor dem Anschließen des TP04100A an die Netzspannung ist zu überprüfen, ob die anliegende Wechselspannung und Frequenz den für das TP04100A auf seinem Leistungsschild (an der Rückseite des Steuerteils) angegebenen Werten entspricht.

VORSICHT 4: Beim Positionieren oder Verstellen des Stativarms ist die Wärmewand stets festzuhalten.

VORSICHT 5: Verwenden Sie die geeigneten Handhabungs- und Verpackungsverfahren für elektrostatisch empfindliche Leiterplatten. Setzen Sie hierbei voraus, daß alle Leiterplatten elektrostatisch empfindlich sind.

VORSICHT 6: Nicht hierzu bevollmächtigtes Personal darf keine Leiterplatten aus der Einrichtung entfernen, die für den Schutz und/oder die Kühlung vorgesehen sind und/oder ein Werkzeug für ihre Entfernung benötigen.

VORSICHT 7: Geeignete saubere und trockene Druckluft für das TP04100A-Gerät verwenden, damit es a) zu keiner frühzeitigen Verfaulung der Filter-/Reglerbaugruppe des Geräts und b) zu keiner Frostbildung im Kältemodul kommt, die den Luftausgangsstrom reduzieren oder blockieren könnte. Eine unzureichende Qualität der Luftversorgung kann die internen Teile des Geräts beschädigen.

Vorsicht 8: Die mit dem System TP04100A mitgelieferte Filter/Reglerbaugruppe ist vorschriftsmäßig zu installieren, einzusetzen und zu warten. Dadurch wird das Eindringen von Feuchtigkeit und/oder Kompressoröl in die Baugruppen des Systems verhindert. Im Vernachlässigungsfall kann das zu einer Beschädigung des Systems führen, die nicht in die Garantieansprüche einbezogen ist.

VORSICHT 9: Die beiden Überhitzung-Sicherheitssensoren (SF1 und SF2) auf der rückwärtigen Wand müssen bei normalem Betrieb mit Kappen verschlossen bleiben. Wenn SF2 beim Einschalten des Geräts nicht verschlossen ist, muß die interne Sicherung durch berechtigtes Servicepersonal ausgetauscht werden, bevor der normale Betrieb aufgenommen werden kann. Nur berechtigtes Servicepersonal darf SF1 und/oder SF2 abtrennen.

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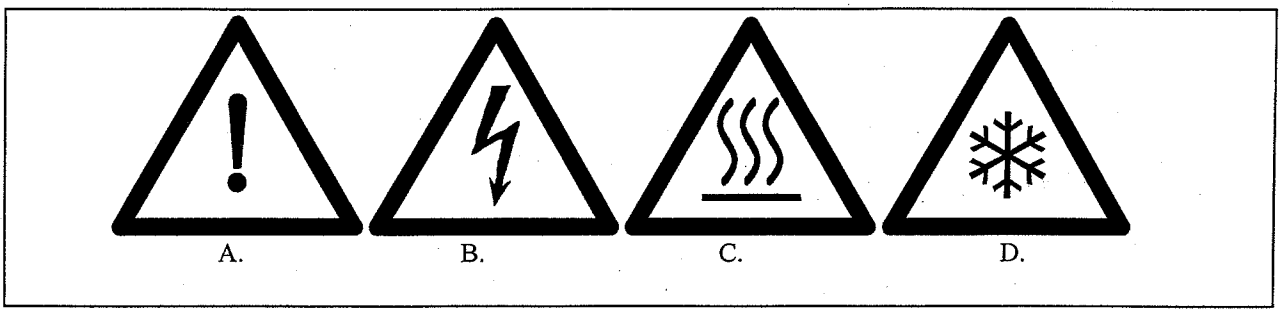
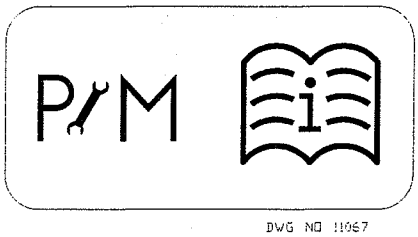
D. PRECAUCIONES DE SEGURIDAD PARA EL PERSONAL DE OPERACIONES



Símbolos: A. Precaución, B. Alta tensión, C. Superficie caliente, D. Superficie fría



Simbolo de Mantenimiento Preventivo

ADVERTENCIA 1: El personal de operaciones debe ejecutar únicamente los procedimientos de mantenimiento o reparación descritos y recomendados en este manual. Unicamente personal calificado, que conozca a fondo los riesgos de choques eléctricos que se podrían presentar dentro del equipo, debe ser permitido efectuar procedimientos de desmontaje o mantenimiento correctivo.

ADVERTENCIA 2: Para evitar riesgos de choques eléctricos, el equipo deberá estar puesto a tierra con una conexión adecuada a tierra física, de acuerdo con los códigos eléctricos locales.

ADVERTENCIA 3: Los lugares donde existen tensiones peligrosas y otros riesgos, tales como superficies calientes, están señalados con rótulos y descripciones en el equipo. Observe cuidadosamente estas advertencias durante la instalación, operación, mantenimiento o al efectuar reparaciones del equipo. Observe también todas las advertencias contenidas en este manual.

ADVERTENCIA 4: Antes de intentar el acceso o reparar los filtros de aire, asegúrese de haber desconectado la corriente alterna de línea y el aire comprimido del Sistema TP04100A. No efectúe estos procedimientos si no está calificado para hacerlos.

ADVERTENCIA 5: Las superficies expuestas dentro y alrededor de la tobera de salida y tapa térmica del sistema funcionan con temperaturas extremadamente altas y frías, las cuales es peligroso tocarlas.

ADVERTENCIA 6: Las piezas dentro de la varilla térmica funcionan a temperaturas extremadamente calientes o frías y es peligroso tocarlas. No ejecute ningún procedimiento de mantenimiento dentro del conjunto de la varilla térmica hasta que el sistema no haya sido apagado y desconectado. Luego, espere hasta que las piezas de la varilla térmica hayan enfriado a una temperatura estable, cerca de la ambiente y sin peligro.

ADVERTENCIA 7: Cuando conecte sensores termopares al dispositivo en prueba (DEP), aisle eléctricamente los sensores para proteger a los operadores contra contactos con cualquier tensión peligrosa en el sitio del DEP.

PRECAUCION 1: Algunos de los materiales de empaque para el embarque del TP04100A, podrían ser una fuente de descarga de electricidad estática. No desempaque la máquina cerca de otros componentes sensibles a la electricidad estática.

PRECAUCION 2: Observe las precauciones indicadas en el equipo y en este manual, para evitar causar daños al equipo.

PRECAUCION 3: Antes de conectar el TP04100A a su alimentación de corriente eléctrica, verifique que la tensión alterna y la frecuencia a ser alimentada al TP04100A sean las correctas, de acuerdo con las listadas en su placa de datos (ubicada en el panel posterior del gabinete del controlador).

PRECAUCION 4: Siempre sujete firmemente la varilla térmica cuando esté colocando o recolocando en posición el brazo del pedestal.

PRECAUCION 5: Use los procedimientos correctos para la manipulación y empaque de placas de circuitos sensibles a la electricidad estática. Tenga en cuenta que todas las placas de circuitos son sensibles a la electricidad estática.

PRECAUCION 6: El personal no autorizado no deberá quitar del equipo los paneles de enfriamiento y/o protección, o los que necesiten de una herramienta para quitarlos.

PRECAUCION 7: Use suministro de aire comprimido adecuado, "Clean Dry Air" (CDA) (Aire seco limpio), para el sistema TP04100A, a) para evitar que el conjunto del filtro/regulador suministrado con el sistema se ensucie prematuramente, b) para evitar la formación de hielo dentro del módulo de enfriamiento y la reducción y obstrucción del flujo de aire de salida. La calidad inferior del suministro de aire podría causar daños a los componentes operativos internos del sistema.

PRECAUCIÓN 8: Instale, use y mantenga en forma apropiada el conjunto de filtro/regulador suministrado con el Sistema TP04100A. De esta manera, se evitará la entrada de humedad y/o aceite del compresor a los componentes operativos del sistema. Si no se verifica este dispositivo, podrían ocurrir daños al sistema no cubiertos por la garantía.

PRECAUCION 9: Los dos sensores de Seguridad de embalamiento térmico (SF1 y SF2), ubicados en el panel posterior, deben permanecer enchufados para la operación normal. Si el SF2 no está enchufado cuando se conecta la corriente al sistema, entonces un técnico calificado deberá cambiar un fusible interno antes de que se pueda reanudar la operación normal. Unicamente personal calificado debe desconectar el SF1 y/o SF2.

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1- General Data

1-1 Contents

1-2 Figures

1-3 Tables

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1-4 Introduction

Information in this manual supports the installation and operation of the Model TP04100A ThermoStream System (see Figure 1-1).

This system is a programmable temperature controlling airstream system for testing and characterizing electronic devices at various temperatures. An internal microcomputer controls the system, permitting either local or remote operation.

The TP04100A display screen shows the active temperature, the temperature setpoints, soak times, ramp rates up and down, how many cycles are being performed and the Device Under Test (DUT) sensor selection.

Additional program screens facilitate programming of Test Setups, system configuration, define the limits of operation, and calibrate the system.

In addition, complete system operation status and any error messages are displayed. All data is shown in real-time alphanumeric format, keeping the user fully informed at all times.

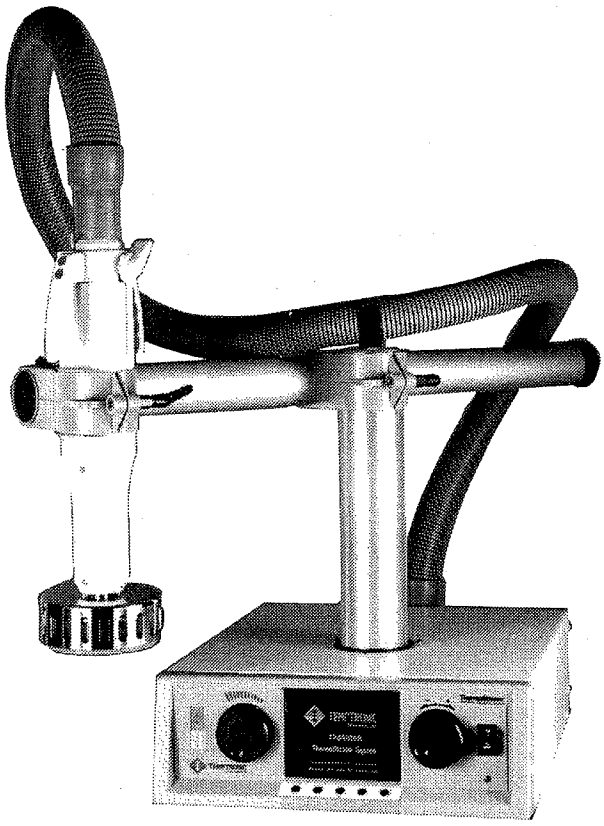

Figure 1-1 Model TP04100A ThermoStream System

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1-5 System Software: Local and Remote Operation

1-5.1 Local Operation

The System's operating program is loaded internally at the factory into programmed devices. Concerning software, refer to the Copyright Statement on back of the Title (Front) page. To operate the system in Program Operation Mode, see Section 3 of this manual. To operate the system in Manual Operation Mode, see the *TP04100A Operator's Manual.*

1-5.2 Remote Operation: ThermoComm Software (Optional)

The System provides three I/O's for three different communication interfaces: Serial (RS232C), Parallel Bus (GPIB) (IEEE-488.2), and ST/EOT/SFF Interface. A summary of the three I/O's (and also of ThermoComm Software, mentioned below) is given in Section 2, "Remote Control Communications." See Section 4, "Remote Interfaces" for detailed instructions and command sets.

ThermoComm Software (optional) is a Windows 3.1/95/98/NT application which enables:

- Remote control of Temptronic equipment
- Unattended logging of test data, and
- Subsequent analysis of test data

It is suggested the end user first verify proper system operation in local mode before attempting to use remote control programs developed by the end user.

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1-6 Registration Cards, Performance Report, Warranty

1-6.1 User/Owner Registration Cards

Four pre-numbered User/Owner Registration post cards are supplied as a single perforated sheet (P/N LMS1480) in the back portion of this manual.

Upon receipt of the system, card #1 should be completed and returned to Temptronic. When ownership changes or additional personnel become responsible for the system, the remaining cards should be used. By following this procedure, you will be assured of receiving any important information pertinent to your system. Additional cards may be obtained through the Temptronic Service Department. See the "Introduction" to Section 5, "Routine Maintenance," for information on how to contact Service.

1-6.2 Performance Report Forms

A "User Interface Performance Report" is provided at the back of this manual. Use this report to submit any desired enhancements or functional discrepancies in the system. For prompt response, you may contact the Temptronic Service Department directly whenever a problem occurs. See the "Introduction" to Section 5, "Routine Maintenance," for information on how to contact Service.

Also, a "Reader Comment" card is included at the back of this manual. Use this card to submit your suggestions and opinions regarding the effectiveness of the manual to Temptronic Corporation.

1-6.3 Warranty

A copy of Temptronic Corporation's standard Warranty is provided in the back portion of this manual

1-7 Specifications

The system specifications are as published on the data sheet(s) which is (are) included in the front cover pocket of this manual, or inserted in the binder rings at the front of this manual, or inserted immediately after the end of this section (after Section 1, prior to Section 2).

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

1-8 System Model Number Designation

A modular system design allows the customer to select options or features as desired for a given installation or application.

Standard system configuration includes controller cabinet, thermal wand, DUT control, IEEE-488.2, RS232C and ST/EOT/SFF interfaces, non-conductive shroud kit, insulation kit, nylon tubing, air filter/regulator, power cord, manuals, etc. An optional Transparent Thermal Cap and Thermal Wand Stand Assembly can be either mounted integral to the controller cabinet or mounted to an optional Benchmount Stand Assembly.

The System Model Number Designation, printed on the TP04100A nameplate, reflects the configuration at time of shipment. Refer to Table 1-1, below.

System Configuration (Model Number): **TP04100** A — ☐

FEATURE	CODE	DESCRIPTION
Temperature Range	A	-20 °C to +225 °C
Power	1	115V AC, 50 or 60 Hz, 1 Ø, 15 amp
	2	230V AC, 50 or 60 Hz, 1 Ø, 10 amp

Table 1-1 System Model Number Designation

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

2- Preparation for Use

2-1 Contents

2-2 Figures

2-3 Tables

2-4 Introduction

This section contains 1) instructions for unpacking, placement, and assembly of the Model TP04100A ThermoStream System, 2) interfacing the system to ~ (ac) power and compressed air service, and 3) how to prepare the Device Under Test (DUT) test fixture site for optimum temperature control, and includes recommendations for proper use of thermocouples.

2-5 Receipt of Shipment

Your Model TP04100A ThermoStream System is shipped to you in one packing carton (see Figure 2-1). The packaged system can be easily transported at your location by two people. Overall shipping size of the packaged system is 20 inches (50.8 cm) deep by 33.5 inches (85.1 cm) wide by 29.5 inches (74.9 cm) high. Overall shipping weight is approximately 78 pounds (35.5 kilograms).

All items purchased are included inside the packing carton. When received, the carton should be examined for any signs of mishandling or damage during shipment.

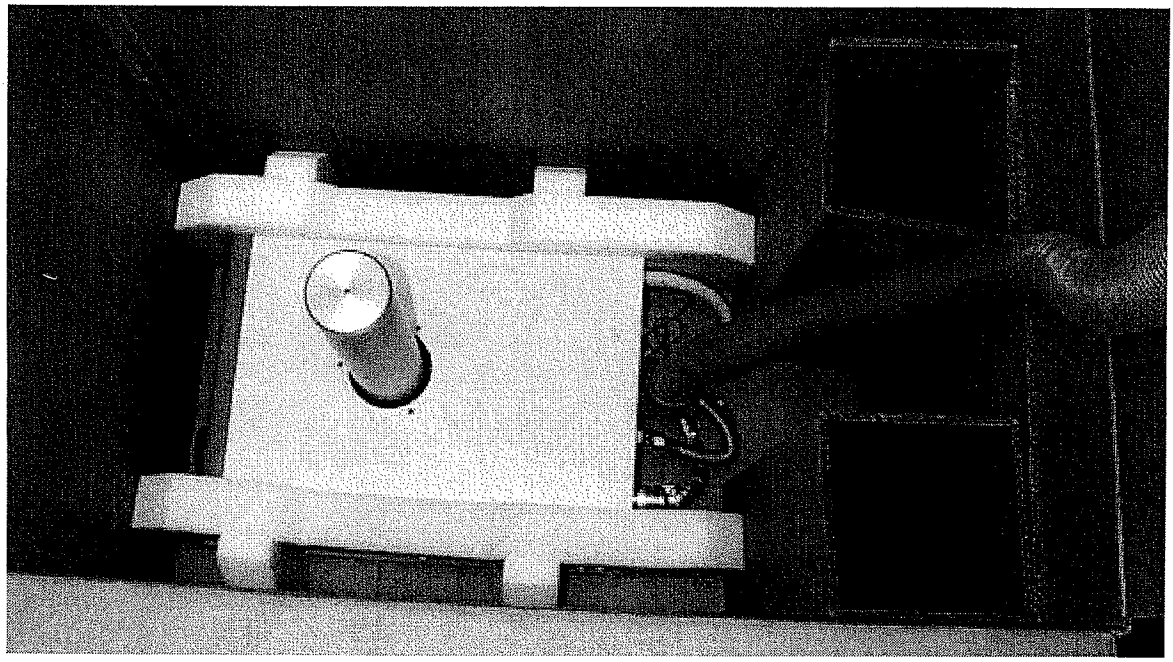

Figure 2-1 TP04100A in Packing Carton for Shipment

NOTE: If you see any obvious signs of damage to the packing carton, contact the carrier immediately and do not proceed with the unpacking. Since the shipment is made FOB factory, you should consult your administration concerning claims for shipping damage.

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

2-6 Placement Requirements

2-6.1 Site and Clearances

The proposed site for placement of the TP04100A should be one near the necessary ~ (ac) power and compressed air service interconnections. Also, the proposed site should be near any tester with which the TP04100A will be interfaced. For proper cooling of the TP04100A and for affording a minimum workspace, the system should be located with minimum clearances: side, 1 inch; rear, 6 inches (see Figure 2-2).

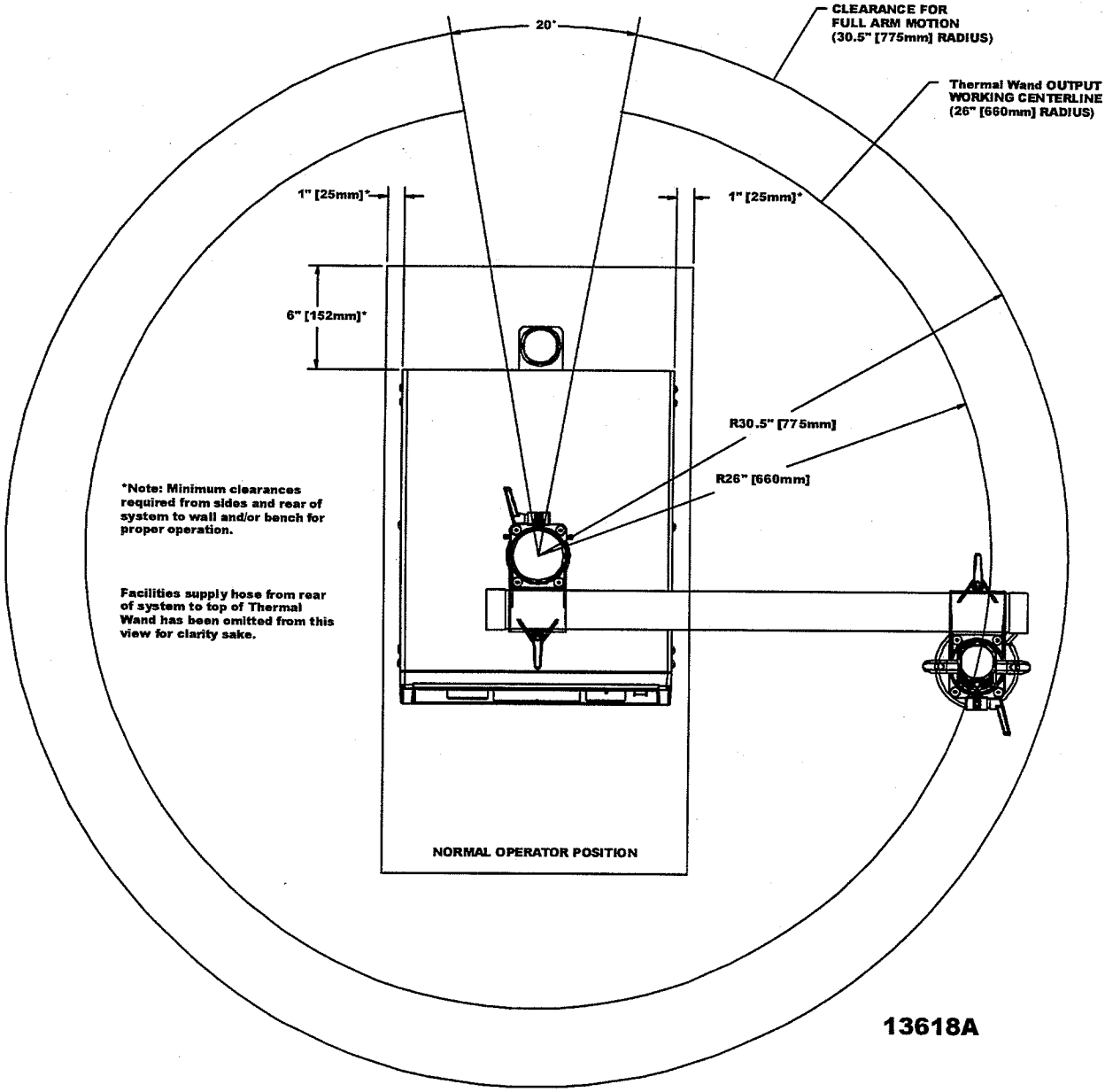

Figure 2-2 Placement Clearances for TP04100A

2-6.2 (AC) Power Standards

The TP04100A includes a standard male IEC 320 power connector socket and a matching, IEC 320, power cord, 2.4 meters (8feet) long.

As specified at the time of purchase, the TP04100A must be connected to a source of single-phase ~ (ac) power as given in Section 1, "Specifications," and the power source must be capable of supplying the required minimum amperes.

To interface the system to a power source, see "Main Power Connection," Section 2-13 on page 2-21.

2-6.3 Compressed Air Standards

The TP04100A is supplied with a 3.7 meter (12 feet) long, 3/8 inch inside diameter, nylon tubing which is used to connect between the System air Filter/Regulator assembly and the System rear panel. Supplies to connect between the System filter assembly and the facility compressed air supply must be provided by the customer.

See Section 5, "Air Filter Element Servicing" for a description of the System air Filter/Regulator.

See Section 1, "Specifications," for required compressed air supply pressure. The supply flow must be capable of the specified minimum litres/second (L/S) Standard Cubic Feet/Minute (SCFM). A supply pressure below the minimum results in a reduced performance.

For sustained **low temperature operation** and testing with the TP04100A, clean dry air must be supplied:

- The reduced dewpoint air is required to prevent the cooling module contained inside the unit from accumulating ice which can reduce and/or obstruct output airflow.
- The cooling module is activated for any temperature setpoint at or below +33°C (+91°F).
- An icing condition may not be readily apparent as the problem can manifest itself as a reduction or total loss of output air flow and/or a loss of temperature control. For optimum system performance a nominal input air dewpoint of -40°C/°F is recommended.

To interface the system to an air source, see "Air Connections," Section 2-14 on page 2-21.

2-7 Unpacking Instructions

When unpacking the system, save all packaging material in the event the TP04100A system has to be reshipped later.

1. Transport the packaged TP04100A to its proposed installation site (if accessible).

   CAUTION 1: Some of the packing materials in the TP04100A shipment may be a source for Electrostatic Discharge (ESD) potential. Do not unpack in the vicinity of ESD sensitive components.

   ATTENTION 1: Se reporter au numéro d'Avertissement ou au numéro d'Attention approprié, dans la section « Consignes de sécurité » au début de ce manuel.

   VORSICHT! 1: Bitte beziehen Sie sich auf die entsprechende Warnungs- oder Vorsichtsnummer im Abschnitt über Vorsichtsmaßregeln am Anfang dieses Handbuchs.

   PRECAUCION 1: Vea el número de la Advertencia o Precaución en la sección de "Precauciones de Seguridad", al comienzo de este manual.

2. Cut and remove the band seals holding the packing carton on its skid (if any). Remove carton strapping and lift off the carton cover and the carton shell. (See Figure 2-1).

3. Visually inspect the TP04100A after unpacking and do not proceed with its preparation for use if any signs of damage are found.

   a. Review the packing slip to verify that all purchased items have been received (see Figure 2-3, below).

   b. Verify that all panel switches are in place and turned off.

   c. Verify the integrity of all exposed cables and connections.

   d. Verify that all visible hardware is secure.

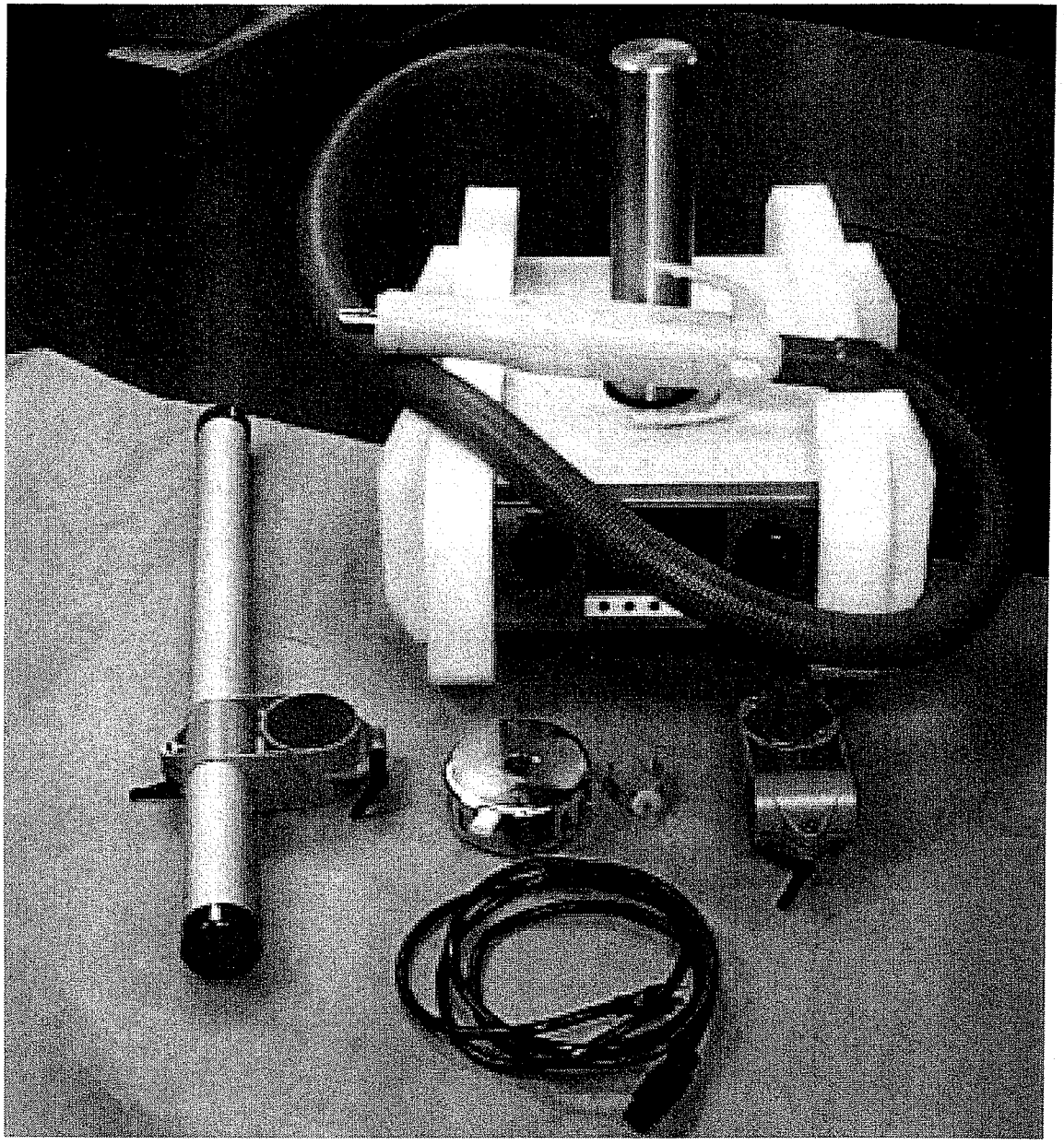

Figure 2-3 Unpacking TP04100A: Base Controller, Arm & Clamps (optional), Thermal Cap (optional), Air Line U-Clamp, Power Cord

NOT PICTURED: Shroud Kit, Foam Rubber Insulation Kit (see Figure 2-11 on page 2-27), Thermocouple Disc Kit (see Section 2-17.2 on page 2-31), and Air Filter/Regulator (see Section 5, "Air Filter Element Servicing").

2-8 Overheat Safety: SF1 and SF2 Sensors

CAUTION 9: The two thermal runaway Safety sensors (SF1 and SF2) located on the rear panel must remain plugged in for normal operation. If SF2 is not plugged in when the system is powered On, then an internal fuse must be replaced by qualified service personnel before normal operation can resume. Only qualified service personnel should disconnect SF1 and/or SF2.

AVERTISSEMENT 9: Se reporter au numéro d'Avertissement ou au numéro d'Attention approprié, dans la section « Consignes de sécurité » au début de ce manuel.

WARNUNG 9: Bitte beziehen Sie sich auf die entsprechende Warnungs- oder Vorsichtsnummer im Abschnitt über Vorsichtsmaßregeln am Anfang dieses Handbuchs.

ADVERTENCIA 9: Vea el número de la Advertencia o Precaución en la sección de "Precauciones de Seguridad", al comienzo de este manual.

Safety regulations require there be two independent levels of protection against overheat and fire.

Thermocouple sensors Safety 1 and Safety 2 (SF1 and SF2), located on the system rear panel (see Figure 2-8), are designed as independent, redundant, safety protection against system thermal runaway.

Leave both SF1 and SF2 plugged into the rear panel at all times: SF1 and SF2 are for system use only.

If SF2 (secured with a protective strap) is not plugged into the rear panel input when the system is powered up, then an internal fuse will blow, disabling heater function. Qualified service personnel are required to replace the internal fuse.

SF1, set at 250 °C, is first activated in the unlikely event the system fails to respond to temperature control from the microprocessor. If SF1 is activated, then the system power must be cycled Off, then On, to reset SF1.

SF2, set at 275 °C, is activated only if SF1 fails to activate. If SF2 activates, then qualified service personnel are required to replace the internal fuse.

The Main Air thermocouple MA TC regulates temperature using a thermocouple located in the Thermal Wand airstream. The MA TC input is located on the rear panel. The two DUT thermocouples, Type K or Type T, with inputs located on the front panel, are an alternative means of temperature control.

For thermocouple interfacing and attaching directions, see Section 2-17.

2-9 Assembly Instructions

Each system is configured to customer specifications at the time of order and shipped complete.

Typically, the assembly required is as follows:

1. Assemble **Thermal Wand Stand Assembly** (optional), see Figure 2-7 on page 2-16.
2. Attach **Thermal Cap** (optional) to the Thermal Wand, see Section 2-10 on page 2-11.
3. Connect **electrical power**, see Section 2-13, on page 2-21.
4. Connect **compressed air**, see Section 2-14 on page 2-21.
5. **Protect test site** (static, moisture, temperature extremes, custom test enclosures), see Section 2-15 on page 2-23 and Section 2-16 on page 2-28.
6. Interface and attach **thermocouples** (optional), see Section 2-17 on page 2-30.
7. Interface to **Remote Control** Communications (optional), see Section 2-18 on page 2-38.

Once assembly is complete, then see "**Initial Start Up**," Section 2-19, on page 2-40.

2-10 Thermal Cap, Thermal Shroud, Purge Air: Attach

Attach the optional, transparent thermal cap onto the bottom of the thermal wand. The tool required is supplied. See Figure 2-4 on page 2-12.

1. At initial installation of the TP04100A, use the supplied allen wrench to fully unscrew the three set screws which are permanently installed in the perimeter of the **thermal cap heat shield**. Fully unscrewing the set screws allows the thermal cap clearance to be installed on the grooved support tube.

2. Apply upward pressure, twist back and forth, and slip (push) the thermal cap into the mounting ring of the wand module.

3. Rotate the thermal cap to locate its exhaust port away from the operator's position, and tighten the three set screws into the grooved support tube to secure the thermal cap in place.

4. Slip the desired size non-conductive **thermal shroud** over the end of the head outlet nozzle to concentrate the air flow around the DUT. Five different size shrouds are provided. Use the appropriate sized one for the type of DUT being tested (replacement shrouds are available from Temptronic).

5. Attach the **purge air** hose to the air purge output fitting, located above the wand handle grips (see Figure 2-5). Then insert the other end of the purge air hose, which is connected to a circular tube perforated with air vents, into the bottom circumference of the **thermal cap** so that the purge air vents upward into the thermal cap. The circular tube fits snugly between the transparent thermal cap wall and the heat shield, and prevents moisture from condensing and fogging the transparent thermal cap (see Figure 2-10, "Typical Test Site: Head, Cap, Shroud, DUT, Air Purge Manifold").

6. To use the system's purge air to a) **purge the tester platform** (but not the thermal cap), simply connect an air hose to the wand air purge output fitting and direct the purge air onto the platform (or connect an air hose to the "PG O" purge output fitting on the rear panel); b) to **purge both the thermal cap and the tester platform**, install a T connector at the wand air purge output fitting to split the purge air output into two air streams: one to purge the thermal cap and one to purge the tester platform.

Attach Thermal Cap as given above, and illustrated below:

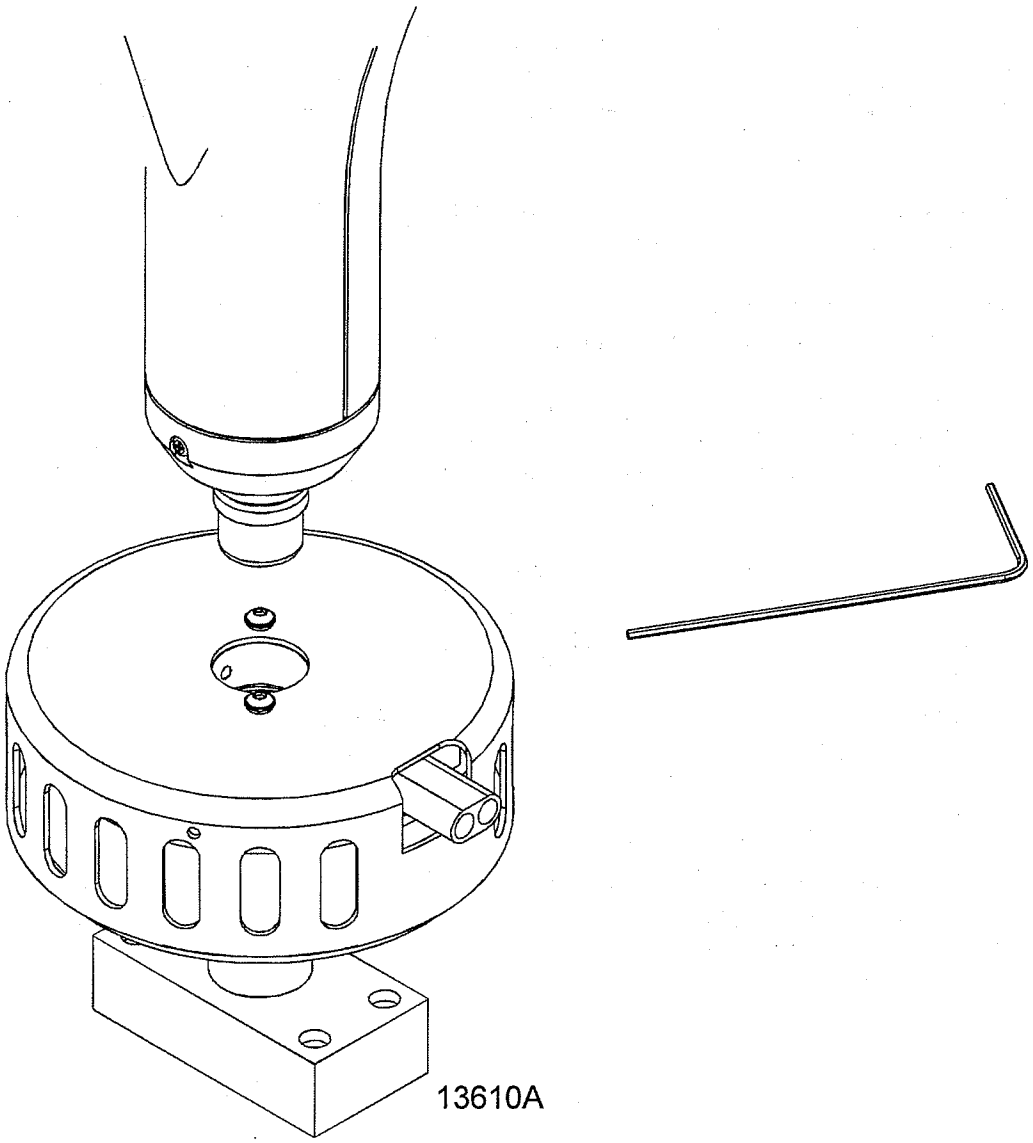

Figure 2-4 Thermal Cap Attachment (Optional Transparent Cap Shown)

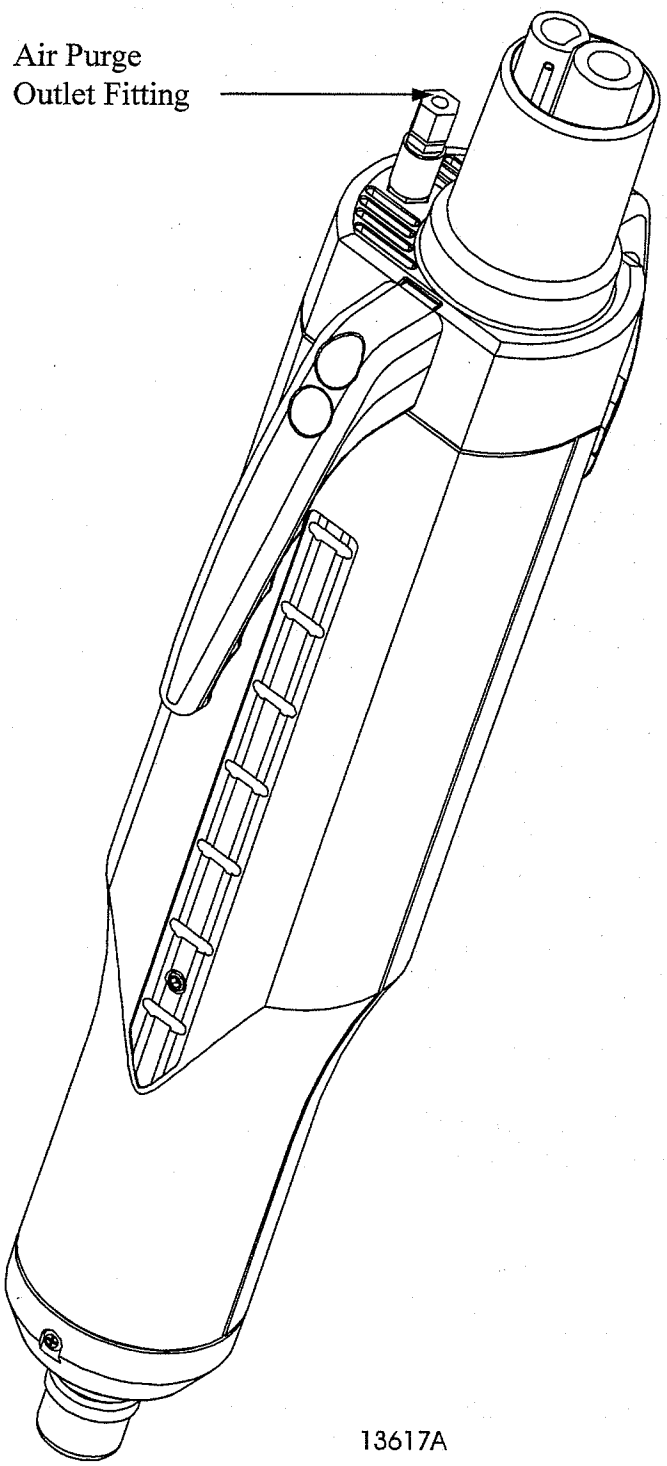

Figure 2-5 Thermal Wand: Air Purge Outlet Fitting

2-11 Thermal Wand Stand: Assembling

2-11.1 Assemble Support Column

To attach and assemble the optional Thermal Wand Stand, first assemble the vertical Support Column, second assemble the Horizontal Arm, the clamp Locks, and seat the Thermal Wand into the assembled stand.

The Wand Hose and Thermal Wand are standard, and are attached at the factory.

To attach the vertical Support Column, proceed as follows, referring to Figure 2-6:

1. Moisten the Rubber Grommet, located in the circular opening on the top of the controller cabinet, with a moist cloth.

2. Moisten the end of the vertical Support Column, which has a Dowel Pin protruding from it.

3. Insert the end of the Support Column, which has the dowel pin protruding from it, into the circular opening on top of the controller cabinet without affecting the location of the Rubber Grommet. This may be accomplished by twisting the Support Column while exerting a downward force.

4. Continue inserting the Support Column into the circular opening until the Dowel Pin is seated in its mating hole in the center of the bottom of the circular opening in the controller cabinet.

5. Place the controller cabinet on its side so that the mounting holes, located on the base of the controller cabinet, are exposed.

6. Rotate the Support Column so that its three threaded mounting holes are concentric with the controller cabinet mounting clearance holes.

7. On each of the three Mounting Screws, place a Lock Washer and a Flat Washer.

8. Insert each of the three Mounting Screws, with lock and flat washers, into the controller cabinet mounting clearance holes and screw completely into the Support Column threaded holes using a 3/16" Hex Key.

9. Slide the Locking Collar down the Support Column and twist the handle to lock (tighten) the Collar. The Collar serves as a base, to prevent the Arm (or Pneumatic Lift) from falling down when swiveled by the operator.

10. Take the Air Line U-Clamp and velcro Strap and attach to top of Support Column using supplied screw.

Once the vertical Column Support is attached, proceed to the following section, and assemble the Horizontal Arm and clamp Locks.

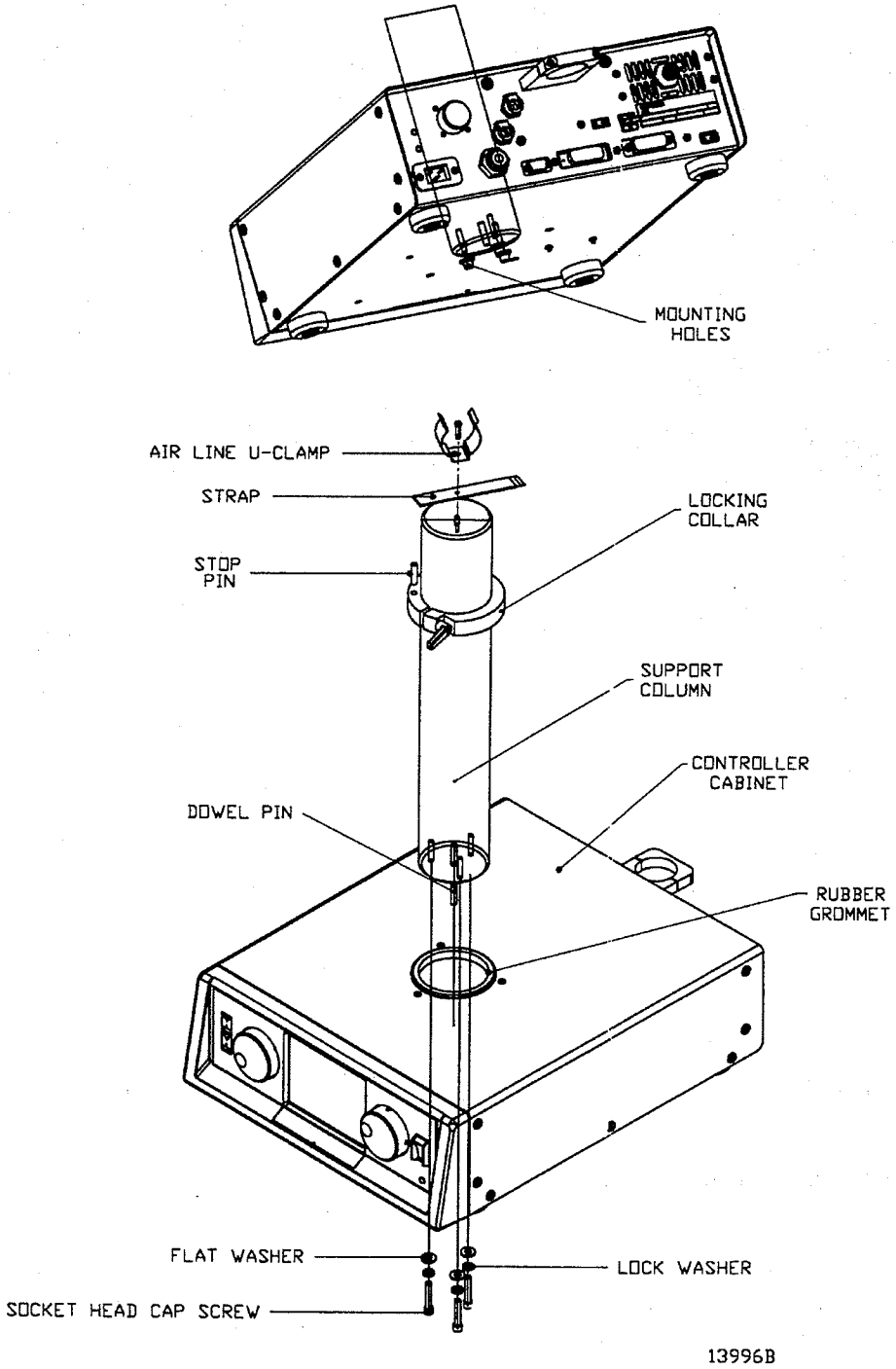

Figure 2-6 Thermal Wand Stand: Assemble Support Column

2-11.2 Assemble Horizontal Arm, Locks

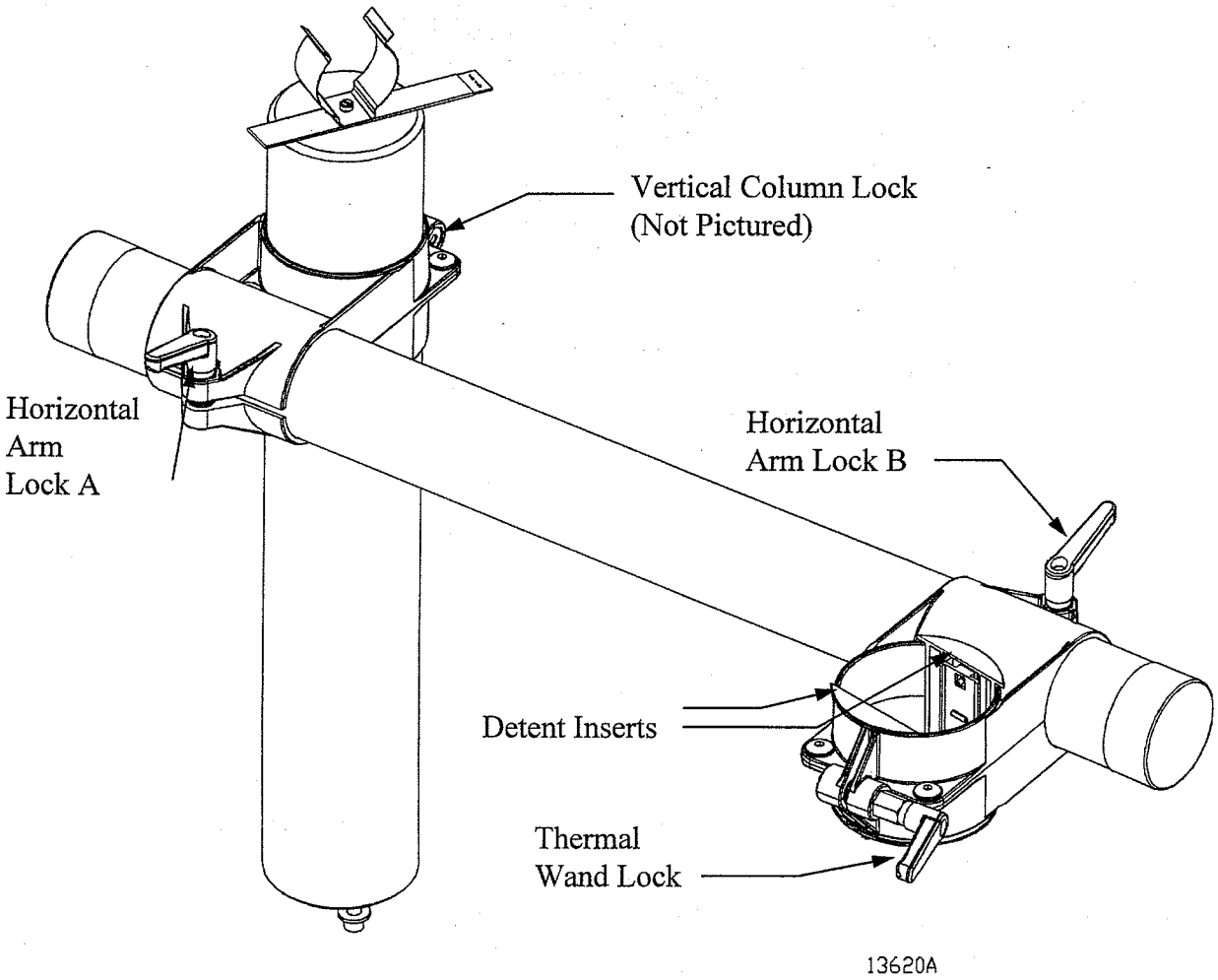

Figure 2-7 Thermal Wand Stand: Assemble Horizontal Arm, Locks

After the vertical Support Column is assembled, proceed to install the Horizontal Arm, the clamp Locks, the Detent Inserts, and to seat the Thermal Wand, as follows (see Figure 2-7):

1. Place the Vertical Column Clamp over the vertical Support Column, and slide it down the Support Column and tighten the Vertical Column Lock. The inside circumference of the Vertical Column Clamp is circular and does not have Detent Inserts within it.

2. Remove the two caps from the ends of the Horizontal Arm, and slide one end of the Horizontal Arm into the Vertical Column Clamp, tighten the Horizontal Arm Lock A clamp, then replace the cap on that end.

3. Take the Thermal Wand Clamp (which contains Detent Inserts inside the clamp circumference, so that the inside circumference is not round but is an oval shape) and slide it over the Horizontal Arm, tighten the Horizontal Arm Lock B clamp, replace the cap on that end.

4. Insert the Thermal Wand inside the Thermal Wand Clamp, seating it within the Detent Inserts, then tighten the Thermal Wand Lock.

To "Manually Position The Thermal Head," see Section Three.

2-11.3 Install Insulation/Heat Shield

This assembly was designed to be both an insulator and a heat shield for the TP04100A ThermoWand. As an **insulator**, this assembly prevents water from condensing and/or frosting on the surface of the ThermoWand during extended low temperature testing.

As a **heat shield**, this assembly protects the user's hand from being exposed to high temperature air flow. This exposure is only a risk when the ThermoWand is being used as a hand held device AND a Thermal Shroud is being utilized without a Thermal Cap.

In applications where a Thermal Cap is being used and no low temperature testing is being conducted for any EXTENDED time periods, the Insulation/Heat Shield assembly may not be necessary.

To Install: slide the assembly over the Nozzle End of the ThermoWand. Be sure the nozzle protrudes from the INSULATION/ HEAT SHIELD ASSEMBY, and that the assembly is slid completely over the nozzle in order to expose the 'Thermal Cap Mounting Groove' which is on the nozzle (see Figure 2-8).

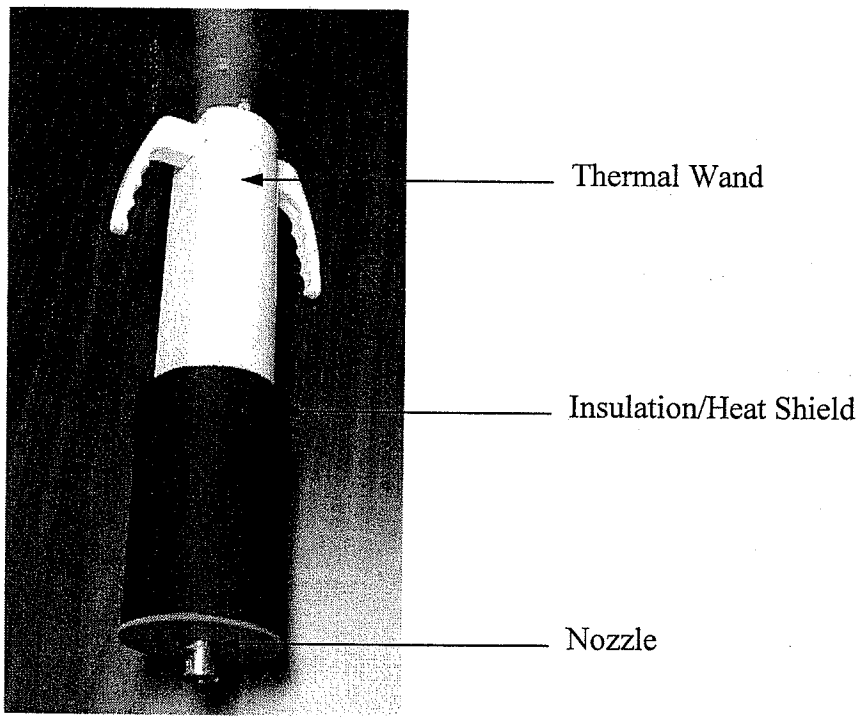

Figure 2-8 Thermal Wand: Insulation/Heat Shield

2-12 System Input/Output Panels

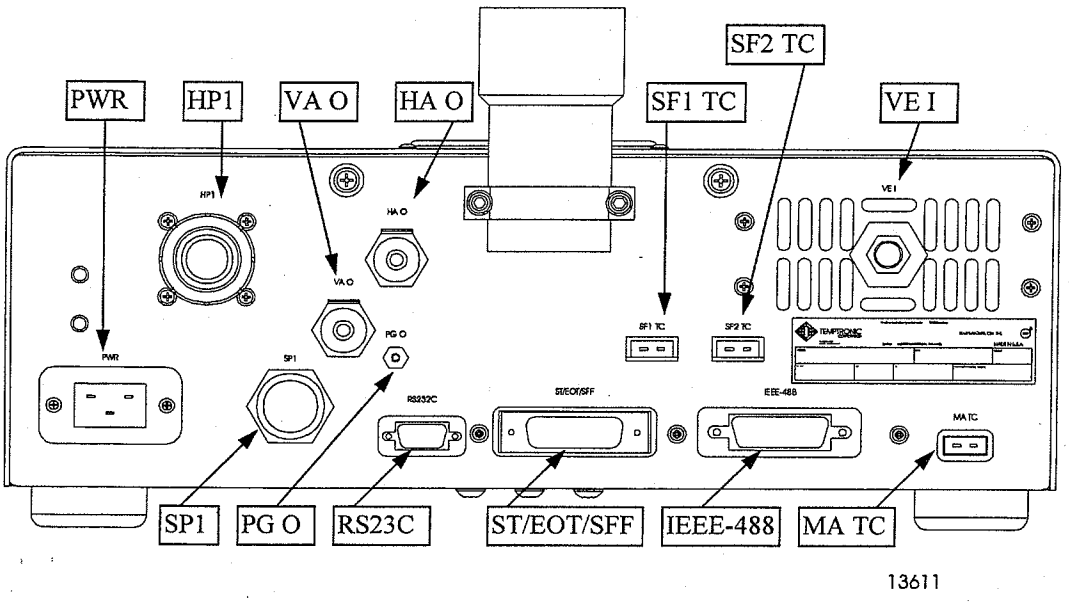

Figure 2-9 System Input/Output (Rear Panel)

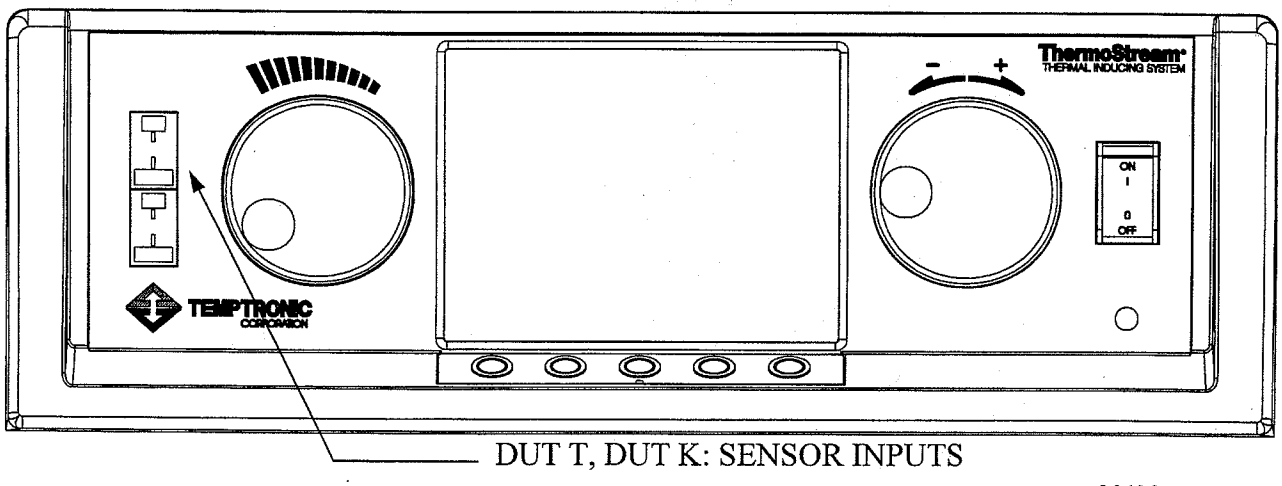

Figure 2-10 Thermocouple Sockets: Dut T, Dut K (Front Panel)

Front and rear panel interconnections are shown above.

Figure 2-9 shows the System Front Panel where the following system interconnections are made: DUT T and DUT K thermocouple sensors (for thermocouple procedures, see Section 2-17).

Figure 2-8 shows the System Rear Panel where the following system interconnections are made: RS232C, IEEE-488.2, and ST/EOT/SFF. Also shown are where to interface (plug in) cables and/or sensors in I/O ports (sockets) as follows:

I/O Port (socket)	Use To Interface
DUT T (on front panel)	Type T Thermocouple Sensor for DUT
DUT K (on front panel)	Type K Thermocouple Sensor for DUT
HA O	Heater Air Out
HP1	Heater Power 1
IEEE-488	IEEE-488.2 Parallel Communications
MA TC	Main Air Thermocouple (use to Calibrate)
PG O	Purge Air Output
PWR	IEC 320 ~ (ac) Power Input
RS232C	RS232C Serial Communications
SF1 TC	Safety1 Thermocouple (system use only)*
SF2 TC	Safety2 Thermocouple (system use only)*
SP1	Supply Pressure 1 (compressed air input)
ST/EOT/SFF	Start Test/End Of Test/Stop on First Fail
VA O	Vortex Air Out
VE I	Vortex Exhaust In

Table 2-1 Input/Output (I/O) Panel Sockets

*Do not disconnect SF1 or SF2: see "Overheat Safety: SF1 and SF2" on page 2-9.

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

2-13 Main Power Connection

The TP04100A interconnections, including IEC 320 power receptacle, are located as pictured on the rear panel of the Controller (see Figure 2-8).

For "AC Power Standards," see Section 2-6.2. Also, observe the following caution:

CAUTION 3: Before connecting the TP04100A to its electrical source, check that the ~ (ac) voltage and frequency to be supplied to the TP04100A are correct for those listed on its data plate (located on the rear panel of the controller cabinet).

ATTENTION 3: Se reporter au numéro d'Avertissement ou au numéro d'Attention approprié, dans la section « Consignes de sécurité » au début de ce manuel.

VORSICHT! 3: Bitte beziehen Sie sich auf die entsprechende Warnungs- oder Vorsichtsnummer im Abschnitt über Vorsichtsmaßregeln am Anfang dieses Handbuchs.

PRECAUCION 3: Vea el número de la Advertencia o Precaución en la sección de "Precauciones de Seguridad", al comienzo de este manual.

1. The TP04100A includes a standard, 2.4 meter (8 feet) long line cord, and IEC 320 male power connector socket.

2-14 Air Connections

See Figure 2-8, "System Input/Output (Rear Panel)," for compressed air input fitting SP1 (Supply Pressure 1), located on the Controller cabinet rear panel.

For "Compressed Air Standards" required for system operation, see Section 2-6.3.

The TP04100A is supplied with a 3.7 meter (12 feet) long, 3/8 inch inside diameter, nylon tubing which is used to connect between the System air Filter/Regulator assembly and the System rear panel. Supplies to connect between the System filter assembly and the facility compressed air supply must be provided by the customer.

Interconnect the compressed air supply as follows.

1. Locate the air Filter/Regulator Assembly (supplied separately as SA13310) in a convenient place between the user-supplied compressed air source and the Controller rear panel. Attach the mounting bracket of the Filter/Regulator Assembly to a secure surface with two mounting screws (not supplied). See Section 5, "Air Filter Element Servicing" for a description of and drawing of the System air Filter/Regulator Assembly.

2. With the user supplied tubing, connect the compressed air source to the Filter/Regulator air input. With the nylon tubing (supplied, P/N VV02400), connect the Filter/Regulator output to the Controller air input (SP1). Use appropriate hose clamps to secure each hose end between the compressed air source and the Filter/Regulator.

3. **NOTE**: Refer to the "Specifications" data sheet included in Section 1 for the compressed air requirements.

4. Turn on the compressed air supply to the Filter/Regulator.

5. Set the regulator on the Filter/Regulator for a reading of 80 psi on its pressure gauge.

2-15 Static, Moisture, Temperature Extreme Protection

2-15.1 Overview

Temperature transition times are dependent on mass, specific heat characteristics, and the thermal coupling and thermal conduction paths to the Device Under Test (DUT), test socket, test leads, and other fixturing features.

This section offers information to optimize test site setup by addressing three related topics:

1. Protecting the test site from the buildup and discharge of static electricity (see Section 2-15.2)
2. Preventing moisture infiltration at the DUT/socket and condensation buildup on the tester platform and cables, the latter to prevent icing (see Section 2-15.3)
3. Minimizing undesired heat transfer at the DUT site to increase test efficiency and protect tester board components from damage due to temperature extreme damages (see Section 2-15.4)

For the option of using one of Temptronic's standard configuration, or application-specific custom thermal test enclosures, see Section 2-16, "Turnkey Test Enclosures."

2-15.2 Electrostatic Discharge (ESD) Protection

Component damaging static electricity can be generated in the normal course of handling sensitive electronic products, principally when two non-conductive surfaces are either rubbed together or separated. Such an electrostatic discharge (ESD) can also be generated by the discharge of compressed air or other inert gases over a surface, regardless of the air jet velocity but increasingly at higher, sustained air jet velocities.

The airflows through Temptronic ThermoStream pneumatic systems have been extensively researched and designed to provide ionically neutral air (free of static charge) at the thermal wand air nozzle output onto the DUT test fixture, so long as the guidelines presented in this manual are implemented.

Temptronic has measured the electric field in the vicinity of the temperature controlled gas discharged from the ThermoStream nozzle, and concluded, the measurements [measured with field meters and probes] of the electric field in the vicinity of the jet does not indicate the presence of a significant or measurable number of charged particles in the jet.

The air flow paths through the TP04100A are fully grounded: from the air inlet to its air nozzle output. Also, when the optional conductive shroud kit (for interfacing to the DUT) is used, an "ESD Protected Test Environment" is assured. It is not normally necessary to add air ionizer equipment to the fixture site to provide ionically neutral air.

Note, however, that relative humidity has a significant impact on the generation of static electricity, and that the next topic, "Moisture Protection," is a factor directly related to ESD control.

2-15.3 Moisture Protection

2-15.3.1 Overview

With reference to the typical test site, there are two principal areas to protect from moisture:

1. The DUT and the test socket in which the DUT is seated (the area below the thermal cap onto which ThermoStream air is directed).

2. The tester platform (test board) and its test cables, socket lead wires and related interconnections (normally exposed to room air temperatures).

See below for how to insulate the DUT/socket, and how to use purge air for the tester platform area.

2-15.3.2 Seal Out Moisture Inflows: DUT & Socket

Although the pneumatic design of the system and conditioning of ThermoStream airflows work to deliver dry air to the DUT within or below the thermal cap, it is necessary to provide a tight seal between the lower edge of the thermal cap and the upper surface of the tester platform when the thermal wand moves up and down to allow inserting and extracting the DUT (see Figure 2-10 "Typical Test Site").

To make a tight seal, install the provided silicone foam insulating material onto the tester platform surface, as described in Section 2-15.4, "Temperature Extreme Protection," and as shown in "Figure 2-11 Typical Insulation for DUT."

2-15.3.3 Air Purging the Tester Platform

Condensation, frosting and ice can appear on the tester platform (test board) and its test cables, socket lead wires, and related interconnections, during low temperature testing unless the platform area is properly purged with system-supplied dry air as given below.

For instance, if the tester platform is exposed to ambient room air which has a dew point on the order of 15 °C, and if the ThermoStream outlet air is at a low temperature, then thermal conduction and forced convection may cause condensation, frosting and/or icing to appear on the tester cables.

The best way to prevent these conditions is to provide an air gap around the tester platform lead wires and cables and to purge the area with dry air.

The TP04100A supplies purge air from an air purge outlet located on the back panel of the controller. The purge air may be directed to where condensation is to be prevented. To attach purge air hoses, see "Attach Thermal Cap, Thermal Shroud, Purge Air," Section 2-10 on page 2-11.

At low temperatures, ThermoStream airflow has a very low dew point. Since it is very dry, condensation within the thermal cap is not a concern.

Also, Temptronic can provide either standard or custom thermal test enclosures for your test site (see Section 2-16, "Turnkey Test Enclosures").

2-15.4 Temperature Extreme Protection

2-15.4.1 Insulation: Minimizing Heat Conductivity

Before the testing of devices is initiated, at either elevated and/or reduced temperatures, the DUT site should be carefully prepared by inserting insulation materials to minimize undesired paths of heat transfer and to reduce moisture inflows to the DUT site:

1. Minimize heat transfer by thermal conductivity from the DUT socket site (within the thermal cap) to the external test equipment to increase efficiency (and reduce moisture infiltration).

2. Protect components on the tester board in the vicinity of the DUT from the temperature extremes of the ThermoStream air flow.

Utilizing a thermal shroud confines the temperature controlled air within the immediate area around the DUT and socket (see "Thermal Cap and Thermal Shroud Attachment," Section 0).

Temperature transition times, however, are dependent on mass, specific heat characteristics and the thermal coupling and thermal conduction paths to the DUT, test socket, test leads, and other fixturing features. To minimize conductivity, fit and seal insulation materials as given below.

2-15.4.2 Insulation Kits: Fitting and Sealing

Each TP04100A is supplied with a standard insulation kit (P/N ZAK101890) which contains a sheet ¼ inch thick of 12-inch square silicone foam material.

The silicone material combines the property of low thermal conductivity, and resistance to temperature extremes, and has the added feature of elasticity. It can be cut to fit snugly around a given component configuration, thereby forming a seal to minimize heat transfer.

See Figure 2-10 and Figure 2-11 for a typical test site installation of the insulation material.

Should more insulation material be required, an optional insulation kit (P/N SA22450) contains three sheets (1/8-, 1/4-, and 1/2-inch thick) of 18-inch square silicone foam material.

Both of these optional kits come with RTV adhesive. For convenience, pieces and sheets of the silicone foam may be cemented together with an RTV adhesive. For separate pieces of available foam material and adhesive, contact the Temptronic Service Department.

AT TEST TEMPERATURES BELOW ROOM AMBIENT

1. DUT AND TEST SOCKET MUST BE MOISTURE PROTECTED BY USING THE THERMAL CAP TO SILICONE RUBBER SEAL.
2. BEST MOISTURE PROTECTION OF TESTER ELECTRONICS CAN BE ACHIEVED BY PROVIDING AN AIR GAP AROUND TEST SOCKET LEADS AND PURGING THE AREA WITH DRY AIR.
3. BY UTILIZING A THERMAL SHROUD TO CONFINE THE TEMPERATURE CONTROLLED AIR WITHEN THE IMMEDIATE AREA AROUND THE DUT AND SOCKET, BETTER HEAT TRANSFER CAN BE ACHIEVED FROM AIRSTREAM TO DUT.

NOTE: TEMPERATURE TRANSITION TIMES ARE DEPENDENT ON MASS, SPECIFIC HEAT CHARACTERISTICS AND THE THERMAL COUPLING AND THERMAL CONDUCTION PATHS TO THE DUT, TEST SOCKET, TEST LEADS AND OTHER FIXTURING FEATURES.

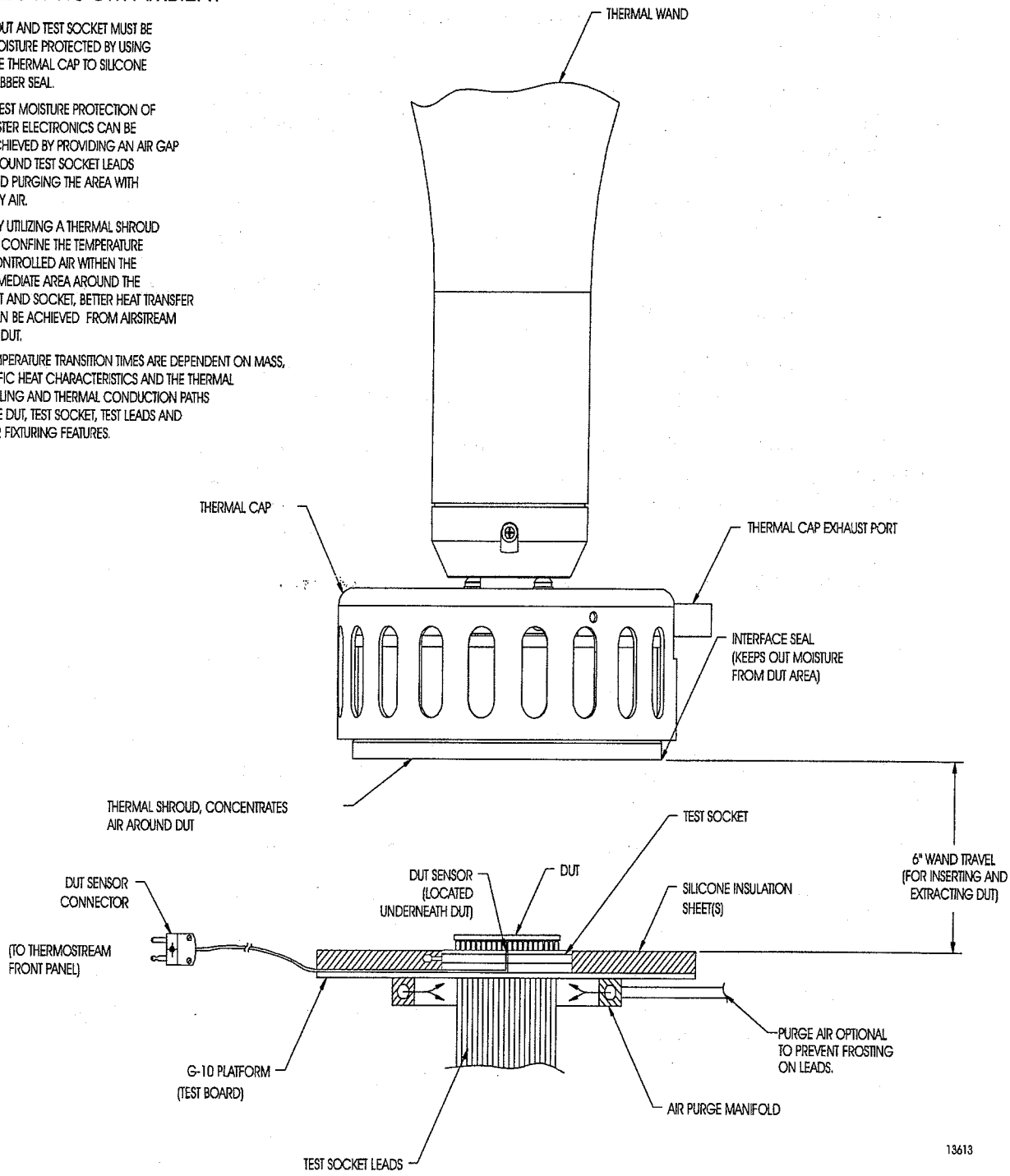

Figure 2-11 Typical Test Site: Head, Cap, Shroud, DUT, Air Purge Manifold

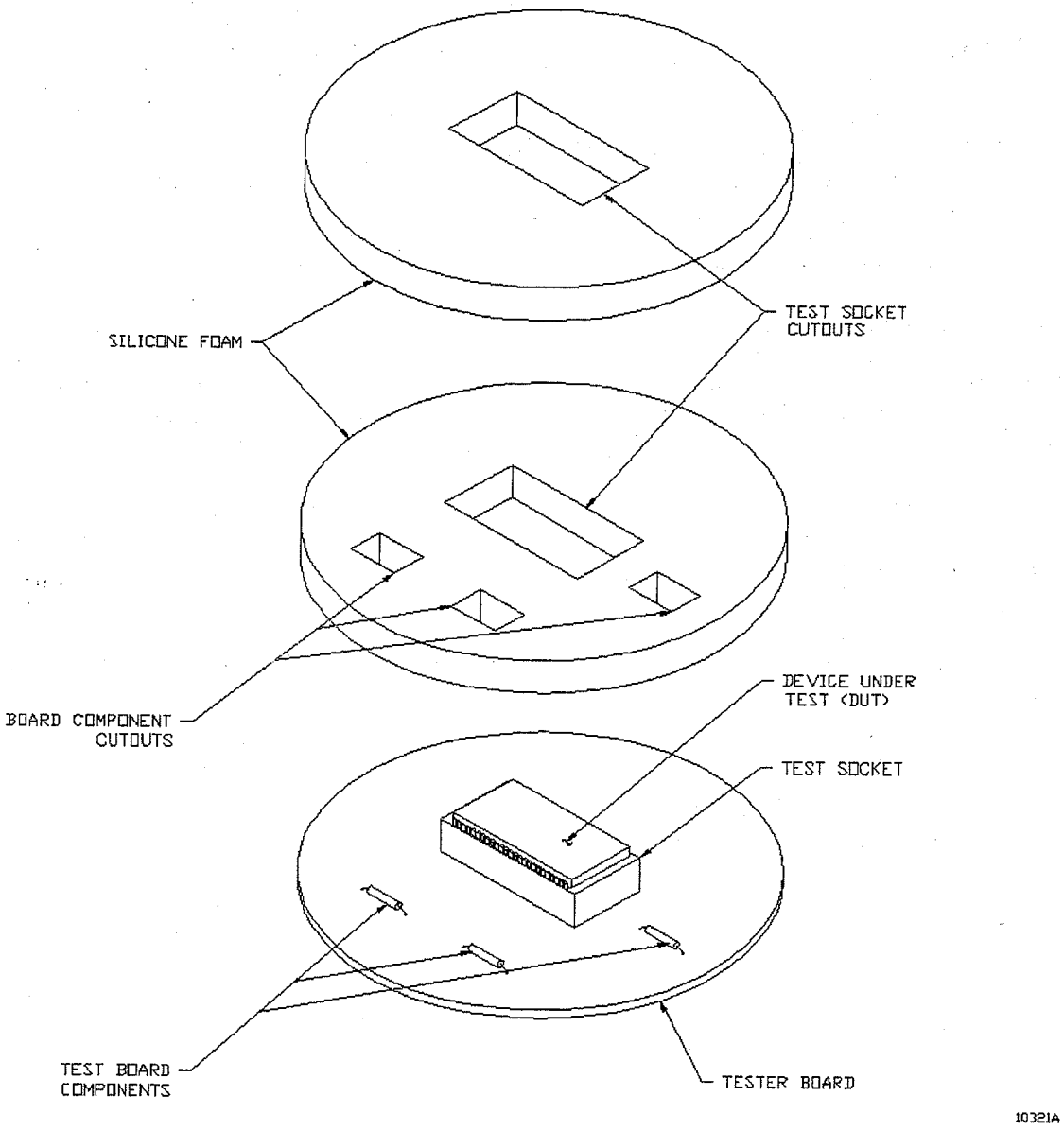

Figure 2-12 Typical Insulation for DUT

2-16 Turnkey Test Enclosures

2-16.1 Overview

Temptronic Corporation can offer the end user a turnkey solution to thermal testing requirements by providing optional test enclosures in two configurations:

1. **Standard** (previously designed, tested, configured for a broad range of applications)
2. **Custom** (designed for a unique, application-specific test environment)

and has been successfully designing and delivering such test enclosures for over twenty-seven years.

These enclosures are available to integrate with any of the major testers or probers, can be fully ATE compatible with convenient "plug in" tester interfaces, and they provide true, accurate temperature control over and beyond the MilSpec temperature range.

These enclosures apply to testing, characterization and failure analysis of printed circuit boards (PCBs), component arrays, hybrids, and small electronic and electromechanical subassemblies, including multichip modules (MCMs), radio frequency (RF), microwave, or digital high speed, high power devices, and provide ESD-free and frost-free test environments.

Two specialized test enclosure configurations are available: the **ThermoFixture** and the **Custom Thermal Test Enclosure (CTTE).**

For a portfolio of ThermoFixture or CTTE solutions, please contact Temptronic Corporation directly.

Note: Due to the limited flow capacity and low temperature limit of the TP04100A, the application of ThermoFixtures and/or CTTEs is limited; please contact Temptronic Corporation for application assistance.

2-16.2 Custom Thermal Test Enclosure (CTTE) (Optional)

The CTTE is an optional enclosure which allows manual probing at temperature of PCBs, component arrays and small subassemblies.

One CTTE design configuration is to utilize Temptronic's patented "pierce-through, fog-free window," a three pane transparent surface which self heals the original puncture after the probe needle is retracted from the PCB or subassembly under test.

A purge air feature keeps the windows frost-free.

A CTTE can be configured with a "pierce-through, fog-free window" on two sides to allow two operators simultaneous access, or one operator access to both sides without having to remove, rotate and reinsert the Device Under Test.

CTTEs are available for both edge-connector and in-circuit bed-of-nails PCB test applications and can be configured to meet a variety of test requirements.

A ThermoFixture holds the module or device in a custom socket at temperature in an airtight environment and utilizes dual-loop direct DUT temperature sensing.

However, to sense and to control air temperatures in a Custom Thermal Test Enclosure, an external DUT sensor is located in the air exhaust port and thermocouples are then connected to the ThermoStream's DUT controls.

2-17 Thermocouples: Interfacing and Attaching

2-17.1 Overview

In general, there are two functional modes available in which to operate the TP04100A. Both modes allow test setup and test running (for detailed explanations see Section 3, "Program Operation").

The two modes are 1) air mode (which uses the main airstream temperature as primary control), or 2) DUT mode (which uses the DUT temperature as primary control).

To operate in DUT mode requires the operator to interface a thermocouple sensor directly onto the DUT.

A **thermocouple** is a temperature measurement sensor that consists of two dissimilar metals joined together at one end (a junction) which produces a small thermoelectric voltage when the junction is heated. The change in thermoelectric voltage is interpreted by thermocouple thermometers as a change in temperature.

This Section explains:

a) How to **interface** (install) a thermocouple to the TP04100A and the related **tester fixture** socket (see Section 2-17.2, "Standard Thermocouple Interfacing")

b) How to **attach** a thermocouple to a DUT (see Figure 2-13 on page 2-36) by **alternative techniques** for applications where standard sensor to DUT socket fixturing does not apply.

To **calibrate** a thermocouple, see Section 5, "Verification" and "Calibration."

2-17.2 Standard Thermocouple Interfacing

2-17.2.1 Sensor Interface Guidelines

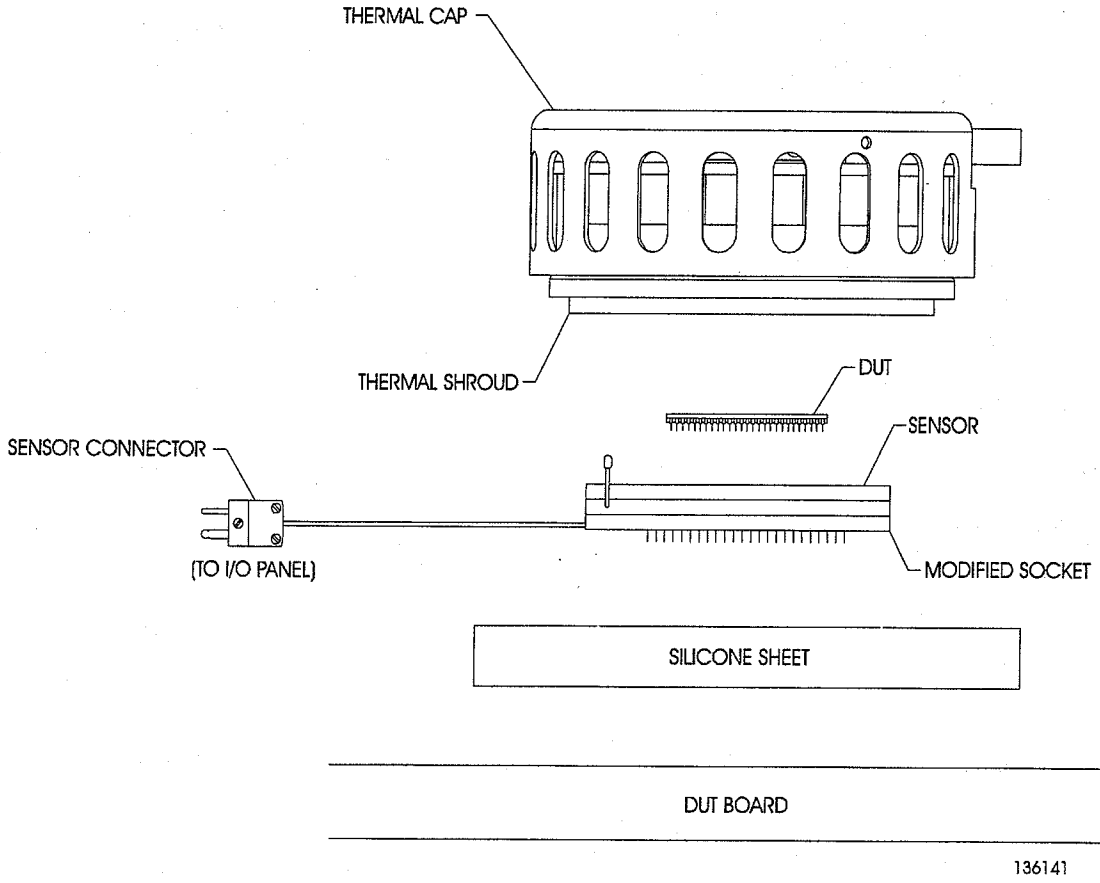

Figure 2-13 DUT Test Fixture Interface

The System permits the DUT to be placed within the temperature control loop (see Figure 2-13, "DUT Test Fixture Interface") by accepting input from an external thermocouple.

Follow these sensor interfacing guidelines:

1. All materials used in fixturing should be capable of withstanding the total system specified temperature range as listed in the System Specification (see Section 1, "Specifications").

2. The DUT sensor must be located within the test fixture, be in contact with the DUT, and be properly connected to the appropriate Input port (socket) on the System front panel (see Section 5, "Thermocouple Input Access").

3. When removing and installing the thermocouple plug at the System Front Panel port, take care to observe thermocouple connector polarity.

Follow these sensor interfacing guidelines:

1. All materials used in fixturing should be capable of withstanding the total system specified temperature range as listed in the System Specification (see Section 1, "Specifications").

2. The DUT sensor must be located within the test fixture, be in contact with the DUT, and be properly connected to the appropriate Input port (socket) on the System front panel (see Section 5, "Thermocouple Input Access").

3. When removing and installing the thermocouple plug at the System Front Panel port, take care to observe thermocouple connector polarity.

4. The sensor should be durable, be of low mass to retard conductivity, with reasonable surface contact area, and be mounted such that it is thermally isolated from the socket to eliminate heat sinking.

5. The fixturing should ensure repeatable contact with the DUT.

6. The tested device body should not contact the socket body.

7. **Do not ground the sensor:** if the DUT case is grounded, then isolate the sensor by using a material which is electrically nonconductive but is an excellent thermal conductor.

8. It is preferable that the thermocouple junction and approximately 20-30x the thermocouple wire diameter be in contact with the center of the DUT to minimize heatsinking (see Figure 2-13, "Alternative Thermocouple Attachment").

9. Mount the sensor beneath the DUT to shield it from high velocity ThermoStream air.

10. If the sensor is mounted on top of the device and is in the airstream, then time/temperature measurement will not be the required DUT temperature but be some weighted average of both device and air temperatures.

11. Use silicone rubber as an insulated base on which the test socket is centered and mounted; make the base large enough to accommodate the Thermal Cap for proper sealing (see Section 2-15.4.2, "Insulation Kits: Fitting and Sealing").

12. When modifying the test socket to accept temperature sensors (per the supplied drawings), care should be taken to prevent any stress in the sensor lead wires.

2-17.2.2 T-type Sensors: Disc Style vs. Spring Style

Two T-type (Copper/Constantan) thermocouple assemblies are available for the system: a disc style and a spring style.

The **disc style assembly** features a circular sensor element to contact the DUT underside (see Drawing 4714, at end of Section 2).

The **spring style assembly** features a narrow rectangular sensor element mounted on a spring to contact the DUT underside (see Drawing 4322, at end of Section 2).

The disc style tends to contact a larger DUT surface area than the spring style and is more responsive than the spring style (approximately 2x to 3x faster): it should be used if test speed and device throughput are critical.

The spring style, however, is more rugged than the disc style, and if spring style response time is adequate for the application, then the spring style may be a better choice.

2-17.2.3 T-type Sensor: Disc Style (Supplied)

To interface the factory supplied T-type disc style thermocouple, follow these steps in accordance with Section 2-17.2.1, "Sensor Interface Guidelines:"

1. Install the sensor element on the DUT test socket to contact the DUT when inserted in the socket. See Drawing 4714 (at end of Section 2) and follow the concepts therein to modify the test socket .

2. Plug the connector on the other end of the thermocouple wiring into the "DUT T" port on the System Front Panel (see Figure 2-9).

If the interface steps above are not consistent with your test specimen application, then see the alternative thermocouple to DUT attachment techniques in Section 2-17.3.

2-17.2.4 T-type Sensor: Spring Style (Optional)

To interface the optional T-type spring style thermocouple, follow these steps in accordance with Section 2-17.2.1, "Sensor Interface Guidelines:"

1. Install the sensor element on the DUT test socket to contact the DUT when inserted in the socket. See Drawing 4322 (at end of Section 2) and follow the concepts therein to modify the test socket .

2. Plug the connector on the other end of the thermocouple wiring into the "DUT T" port on the System Front Panel (see Figure 2-9).

If the interface steps above are not consistent with your test specimen application, then see the alternative thermocouple to DUT attachment techniques in Section 2-17.3.

2-17.2.5 K-type Sensor

To interface an operator supplied K-type (Chromel/Alumel) thermocouple, follow these steps in accordance with Section 2-17.2.1, "Sensor Interface Guidelines:"

1. Install the sensor element according to the detailed instructions supplied by the thermocouple vendor: the sensor element must be installed on the DUT test socket to contact the DUT when the DUT is inserted in the socket.

2. See the Drawings referenced for T-type factory supplied thermocouples, above, and follow the concepts therein to modify the test socket .

3. Plug the connector on the other end of the thermocouple wiring into the "DUT K" port on the System Front Panel (see Figure 2-9).

If the interface steps above are not consistent with your test specimen application, then see the alternative thermocouple to DUT attachment techniques in Section 2-17.3.2 on page 2-35.

2-17.3 Alternative Thermocouple Attachment

2-17.3.1 Thermocouple Construction and Attachment Guidelines

Proper thermocouple to DUT contact is essential to insure accurate temperature sensing.

If the standard interface steps given earlier (see Figure 2-12, "DUT Test Fixture Interface") are not consistent with your test specimen application, then the following alternative sensor to DUT techniques may be appropriate.

Follow these steps (in accordance with Section 2-17.2.1, "Sensor Interface Guidelines") to properly construct and attach thermocouples to DUT specimens:

1. For Type T thermocouple construction, use a small gauge (#26, #28, #30, or #36 gauge) teflon or kapton coated copper-constantan thermocouple wire.

2. Using wire thicker than #36 gauge (0.005 inch / 0.013 mm) will conduct more heat between the test specimen DUT and the ambient, resulting in less accurate temperature measurements.

3. Make the thermocouple junction as small as possible.

4. **Do not ground the sensor:** if the DUT case is grounded, then isolate the sensor by using a material which is electrically nonconductive but is an excellent thermal conductor.

5. It is preferable that the thermocouple junction and approximately 20-30x the thermocouple wire diameter be in contact with the center of the DUT to minimize heatsinking (see Figure 2-13, "Alternative Thermocouple Attachment").

6. Mount the sensor beneath the DUT to shield it from high velocity ThermoStream air.

7. If the sensor is mounted on top of the device and is in the airstream, then time/temperature measurements will not be the actual DUT temperature but be some weighted average of both device and air temperatures.

The above techniques are illustrated in Figure 2-13, on page 2-36.

2-17.3.2 Alternative Thermocouple Attachment Techniques

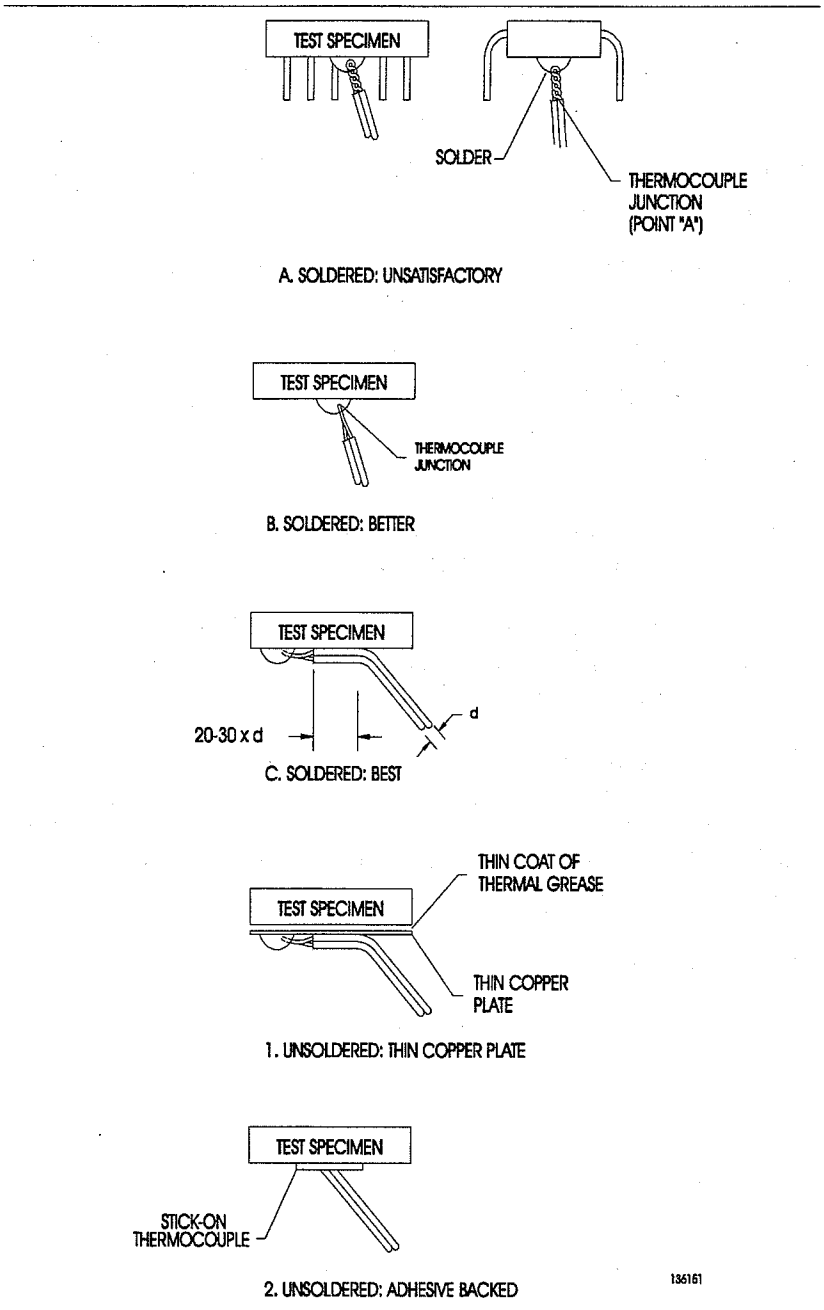

Figure 2-14 Alternative Thermocouple Attachment

For applications where the standard sensor to DUT socket fixturing methods (discussed in Section 2-17.2, "Standard Thermocouple Interfacing") are not appropriate, then reference the above Figure 2-13, "Alternative Thermocouple Attachment," which offers the following selections:

Soldered techniques:

A. **Unsatisfactory:** Junction Does not Contact Solder (Sensor junction is out of direct contact with DUT: wires first join at point "A," temperature is being measured at point "A")

B. **Better:** Junction Contacts DUT but Thermocouple Wire may conduct heat to or from ambient

C. **Best:** Thermocouple Wire Contacts DUT Surface approximately 20-30 Times Diameter of Sensor Wire

Unsoldered techniques:

1. **Thin Copper Plate:** Used with Thin Film of Thermal Grease

2. **Adhesive Backed:** Sensor Element Sticks Directly to DUT

2-18 Remote Control Communications

2-18.1 IEEE-488.2 Interface

For remote control of the TP04100A, an IEEE-488.2 interface is standard for parallel communications with a tester or host computer. The parallel communications cable from the host plugs into the **IEEE-488.2** connector on the TP04100A rear panel (refer to Figure 2-8).

See Section 4, "Remote Interfaces," for IEEE-488.2 interconnections information and special programming instructions.

It is suggested the end user first verify proper system operation before attempting to use programs developed by the end user.

2-18.2 RS232C Interface

For remote control of the TP04100A, an RS232C interface is standard for serial communications with a tester or host computer. The series communications cable from the host plugs into the **RS232C** connector on the TP04100A rear panel (refer to Figure 2-8).

See Section 4, "Remote Interfaces," for RS232C interconnections information and special programming instructions.

It is suggested the end user first verify proper system operation before attempting to use programs developed by the end user.

2-18.3 ST/EOT/SFF Interface

An ST/EOT/SFF interface between the TP04100A and a tester is standard. The interface cable from the tester plugs into the **ST/EOT/SFF** connector on the TP04100A rear panel. Interface connections (signals) include the Start-Test (ST) output from the TP04100A, the End-of-Test (EOT) input from the tester, and the Stop-on-First-Fail (SFF) input from the tester.

See Section 4, Remote Interfaces, for ST/EOT/SFF interconnections information and special programming instructions.

2-18.4 ThermoComm® Software (optional)

ThermoComm Software (optional) allows the user to interface with most Temptronic Thermal Systems. It enables a) remote control, in either serial RS232C mode or (GPIB) parallel bus IEEE-488.2 mode, b) unattended data logging of runtime tests, c) saving and analyzing the logged data.

ThermoComm is a Windows 3.1/95/NT application. As such, the user interface is graphical, user friendly, and menu driven.

ThermoComm includes both a LabView Source-Code level Driver and a built application. If installing the Source-Code level driver, then LabView by National Instruments is required, and enables function on any Windows platform: 3.1/95/NT.

LabView is not required if installing and running only the built application, but the built application without LabView installed will function only on Windows 95 and NT.

For details, contact Temptronic Corporation.

2-19 Initial Start-Up, Check Out, Shut Down

The following procedure outlines initial startup and check out for the TP04100A system, and how to shut down after the system has been operated.

Once the TP04100A is started and you are satisfied that the system works properly, see the following:

- For local, Program Mode operation, see Section 3, "System Operation," in this manual
- For local, Manual Mode operation, see the *TP04100A Operator's Manual*
- For remote, IEEE-488.2 or RS232C operation, see Section 4, "Remote Interfaces," in this manual

2-19.1 Main Power Switch

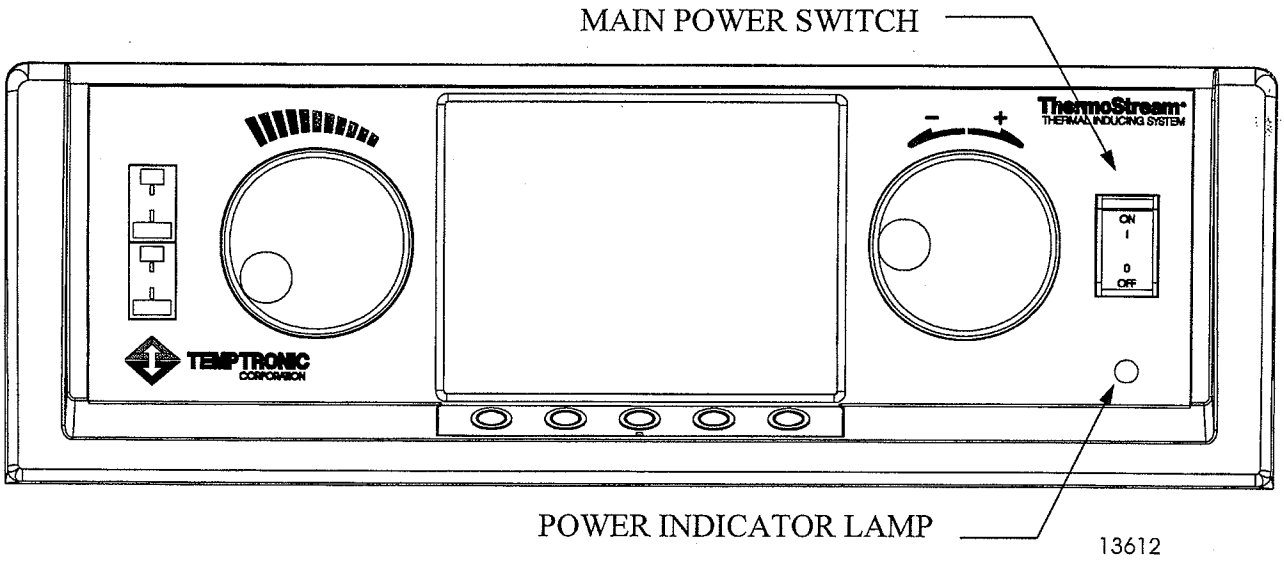

Figure 2-15 Main Power Switch

Figure 2-13 shows the Main Power Switch, located on the right hand side of the controller's front panel. This switch also serves as the primary ~ (ac) power circuit breaker (CB1) for the system. An IEC 320 connector for receiving the input power cord is located on the rear panel of the controller. Note the Power (on/off) Indicator Lamp located below the Main Power Switch. Allow several seconds for the Lamp to light after activating the Main Power Switch.

2-19.2 Startup by Power ON

To startup the TP04100A System initially or after it has been turned off:

1. Check that the system is connected to the specified compressed air source and the air is turned on.
2. Be sure the line cord is connected at the rear panel of the system and is connected to the specified ~ (ac) power source and that the source is live.
3. Be certain that overheat Safety sensors SF1 and SF2 are connected on the rear panel. If SF2 is disconnected, and the system is powered on, then an internal fuse will blow and qualified service personnel will be required to replace the internal fuse. See Section 2-8 on page 2-9.
4. Actuate the Main Power Switch located on the front panel of the controller cabinet upward to the ▌(ON [up]) position to start operation of the TP04100A. Note that the Power (on/off) Indicator Lamp should illuminate.

2-19.3 Initial Check Out

For a flow diagram of the thirteen TP04100A screens, see the Screen Tree appended to the end of Section 3.

1. Observe that the *System Startup Screen* appears on the display.
2. At the *System Startup Screen*, press any button to display the *Top Menu Screen*, then press the "System" button to select the *Configure System Screen.*
3. At the *Configure System Screen*, select the parameters to give the desired system operation (for details, see Section 3, "Configure System"); set "Auto Start MANUAL OPERATION" to On if you wish to start up in Manual Operation Mode; leave Off to start up in Program Operation Mode.
4. After making the proper selections, press "Done" to return to *Top Level Menu.*
5. On the *Top Menu Screen*, press "Flow" to activate the "Flow On-Off Switch," and check that there is air flow from the thermal wand air output nozzle.
6. At *Top Menu Screen*, select either "Manual" or "Program" to setup and run tests (see Section 3)

2-19.4 Shutdown by Power OFF

To shutdown the TP04100A System after it has been turned on and operated:

1. Press the "ESC" Program Button on any program screen to return to the *Top Menu Screen.* This may require one, two or three ESC button presses.
2. Once at the *Top Menu Screen*, actuate the Main Power Switch downward to the **O** (OFF [down]) position to turn off the TP04100A. Note that the power (on/off) indicator lamp should turn off (see Figure 2-14).

NOTE: When moving the TP04100A to a different test location, or when shutting the System down for an extended period, turn off and disconnect system from both its ~ (ac) power source and compressed air supply.

2-20 Repackaging

If the TP04100A System is to be shipped to another location, repackage the system in the original shipping carton (see Figure 2-1).

Note that prior approval is required before shipping the system to a Temptronic Sales/Service Office, or to the factory.

IT IS RECOMMENDED THAT A TAG BE ATTACHED TO THE SYSTEM GIVING THE OWNER'S NAME, ADDRESS, TELEPHONE NUMBER, SYSTEM MODEL AND SERIAL NUMBERS, AND THE REASON FOR RETURN, INCLUDING ANY RETURN MATERIAL AUTHORIZATION (RMA) NUMBERS.

3- System Operation

3-1 Contents: by Heading

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

3-2 Contents: Detailed

3-3 Figures

3-4 Tables

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

3-5 System Overview

3-5.1 Introduction

This section contains instructions for front panel (local) operation of the Model TP04100A ThermoStream System in "Program Operation Mode." For "Manual Operation Mode" see the *TP04100A Operators Manual.* Remote system operation is discussed in Section 4, *Remote Interfaces.*

It is advisable to gain familiarity with front panel (local) operation before attempting remote operation.

In general, there are two temperature control modes available in which to operate the TP04100A, each of which allow test setup and test running:

1. **Main Air mode:** which uses the main air stream temperature as primary control
2. **DUT mode:** which uses the DUT temperature as primary control, and requires a temperature sensor to be interfaced directly to the DUT

Further, there are two major functions performed by the TP04100A, each cross-referenced to their "Overviews" below, then followed by short summaries in this sub-section:

A. **Conducting Tests:** see "Overview," Section3-11.1, on page 3-23.

B. **Setting Up Tests:** see "Overview," Section 3-12.1 on page 3-27.

3-5.2 Conducting Tests

In Program Operation Mode the operator can conduct tests in either of the temperature control modes mentioned above: Main Air mode or DUT mode.

A test will run, however, only if its related test setup parameters have been properly preset.

Program Operation Mode allows for testing:

1. Of **cycling sequences** from 2 up to 10 setpoints, by using the Cycle function on the *Program Operation Screen* or the *Program Test Setup Screen.*
2. **Ramp and soak parameters** for the cycling sequences are selected for the test setup (loaded from 1 of 10 ramp and soak program selections) using the *Program Test Setup Screen.*

3-5.3 Setting Up Tests

Program Operation Mode can access test setups in either of the temperature control modes: Main Air mode or DUT mode.

A test will run, however, only if its related test setup parameters have been properly preset.

- For Main Air mode test setups, see Section 3-13 on page 3-40.

- For DUT mode test setups, see Section 3-14 on page 3-42.

Different test setup files are programmed through the *Program Test Setup Screen* (see Figure 3-12).

By using the factory defaults, or by accessing a previously saved test file, a new file can be programmed by changing the system setup parameters and the temperature setpoint parameters for a particular test. For a detailed summary, see Section 3-12.1.

3-5.4 Self-Tune: DUT Modes

Self-tuning allows the system to "learn" and adapt itself successively to match DUT mass for the best compromise between minimal overshoot and fastest temperature transition time. DUT mode self-tuning is automatic (so long as it is selected on the *Define Parameters Screen*: see Figure 3-11) and optimizes operation by measuring the thermal mass characteristics of the specific DUT against successive system supplied temperature ranges.

3-6 Local Operation

3-6.1 Startup by Power ON

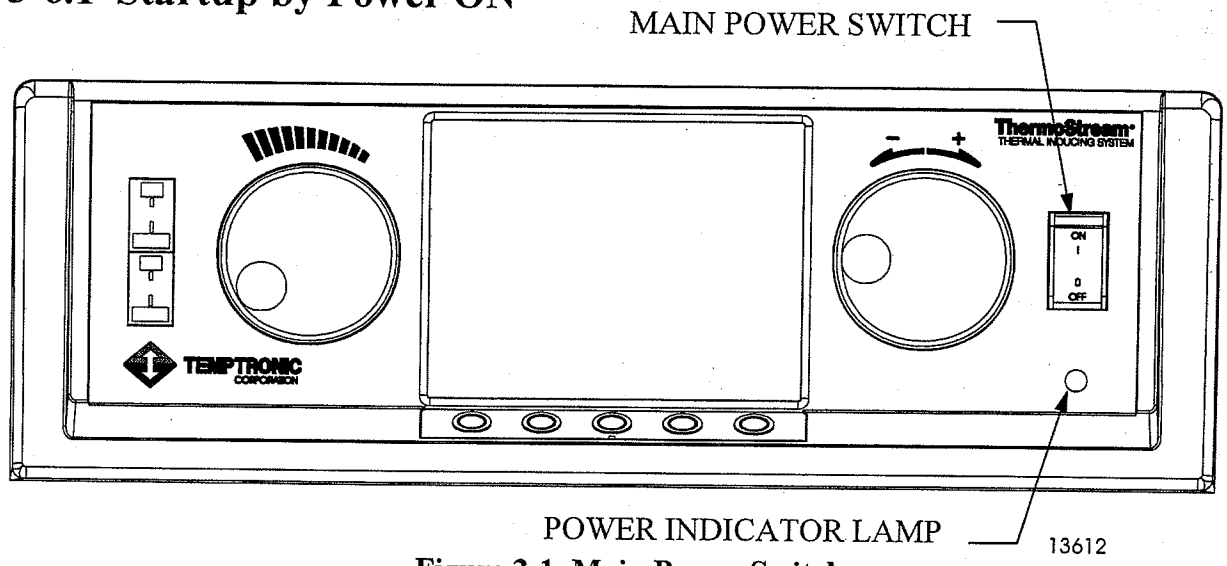

Figure 3-1 Main Power Switch

Figure 3-1 shows the Main Power Switch which is located on the right hand side of the front panel of the controller. This switch also serves as the primary ~ (ac) power circuit breaker (CB1) for the system. An IEC 320 connector for receiving the input power cord is located on the rear panel of the controller.

To startup the TP04100A System initially or after it has been turned off:

1. Check that the system is connected to the specified compressed air source and the air is turned on.
2. Be sure the line cord is connected at the rear panel of the system and is connected to the specified ~ (ac) power source and that the source is live.
3. Be sure that SF1 and SF2 overheat Safety sensors are connected on the rear panel. If SF2 is disconnected, and the system is powered On, then an internal fuse will blow and have to be replaced by qualified service personnel.
4. Actuate the Main Power Switch located on the front panel of the controller cabinet upward to the **I** (ON [up]) position to start operation of the TP04100A. Power (on/off) Indicator Lamp will light.
5. The *System Startup Screen* is displayed after the power has been turned ON. It features the Temptronic Corporation logo and identifies the TP04100A ThermoStream System (see Figure 3-5). The system is ready for operation when the *System Startup Screen* is displayed.
6. If "Auto start in MANUAL OPERATION" is set to "ON" in the *Configure System Screen* (see Figure 3-16), then the system will automatically start in Manual mode, and display the *Manual Operation Screen* (see the *TP04100A Operator's Manual*).
7. Press any Program Button to continue to the *Top Menu Screen.*

3-6.2 Thermal Wand Adjustable Stand (Optional)

Figure 3-2 shows the pivoting and tilting usage of the thermal wand with respect to its adjustable stand manipulator. These adjustments allow the thermal wand to be aligned with the DUT site and for the thermal wand to be positioned near the DUT site when not actively in use.

See Section 2, "Site and Clearances," which depicts the horizontal sweep limits of the thermal wand adjustable stand manipulator.

NOTE: These instructions are applicable to TP04100A Systems with a stand configuration. Skip to Section 3-7, if your system has no arm configuration.

3-6.3 Manually Position Thermal Head

Manual travel and positioning of the wand and stand can be set and held in the desired position by several mechanical locking devices. These locking devices are identified below (refer to Figure 3-2).

VERTICAL COLUMN LOCK (at the top of vertical column exiting the Controller cabinet): can be tightened to clamp any horizontal sweep movement or vertical up/down movement of the horizontal arm of the stand. When this lock is loosened, the horizontal arm can be turned up to 170 degrees in either horizontal direction from the front of the system, and be repositioned up or down along the vertical axis of the column.

HORIZONTAL ARM LOCK "A" (on the same assembly as, but opposite to, the Vertical Column Lock): can be tightened to clamp any rotational and linear movement of the horizontal arm from the vertical column. When this lock is loosened, the horizontal arm can be rotated and moved in and out along its linear axis.

HORIZONTAL ARM LOCK "B"(on the same assembly as, but opposite to, the Thermal Wand Lock): can be tightened to clamp any rotational and linear movement of the Thermal Wand along the horizontal arm. When this lock is loosened, the Thermal Wand can be rotated and moved in and out along the linear axis of the horizontal arm. This lock is pictured in Section 2, "Wand Adjustable Stand: Assembly."

THERMAL WAND LOCK (on the same assembly as, but opposite to, Horizontal Arm Lock B): can be tightened to clamp any rotational and linear movement of the Thermal Wand. When this lock is loosened, the Thermal Wand can be rotated and moved up and down along its vertical axis.

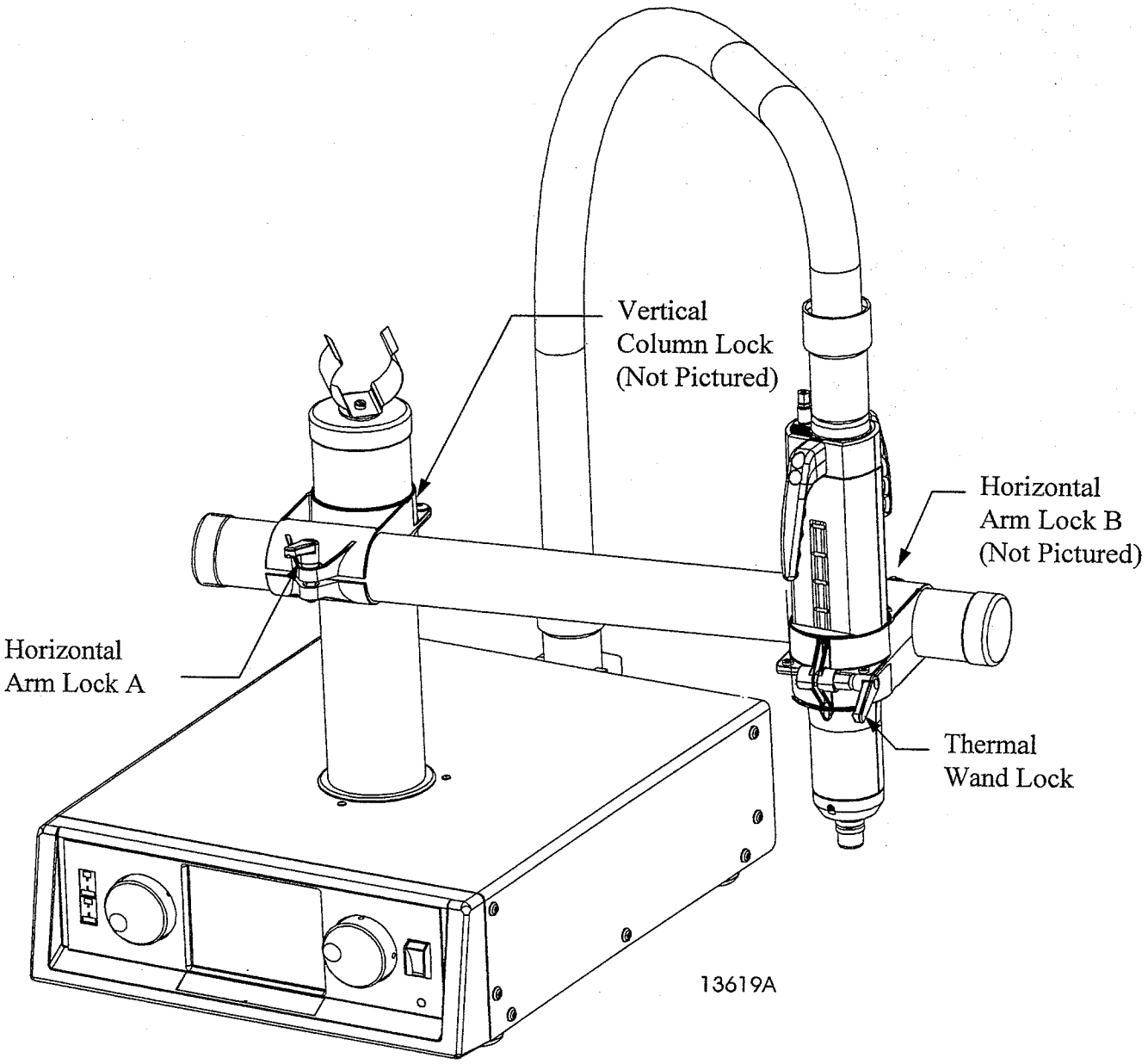

Figure 3-2 Thermal Head Manipulator Positioning

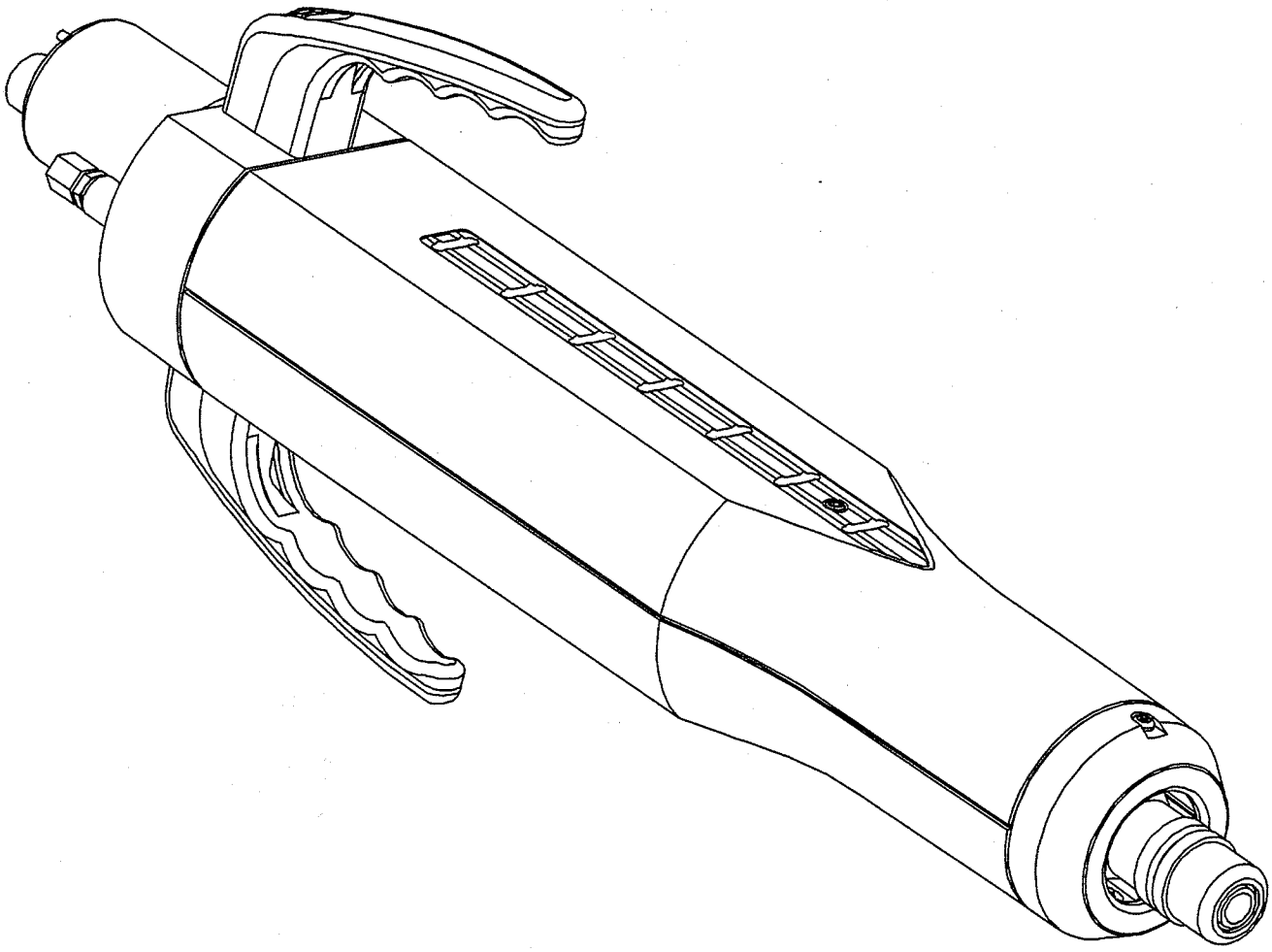

Figure 3-3 Thermal Wand: Handle Grips

3-7 User Interface

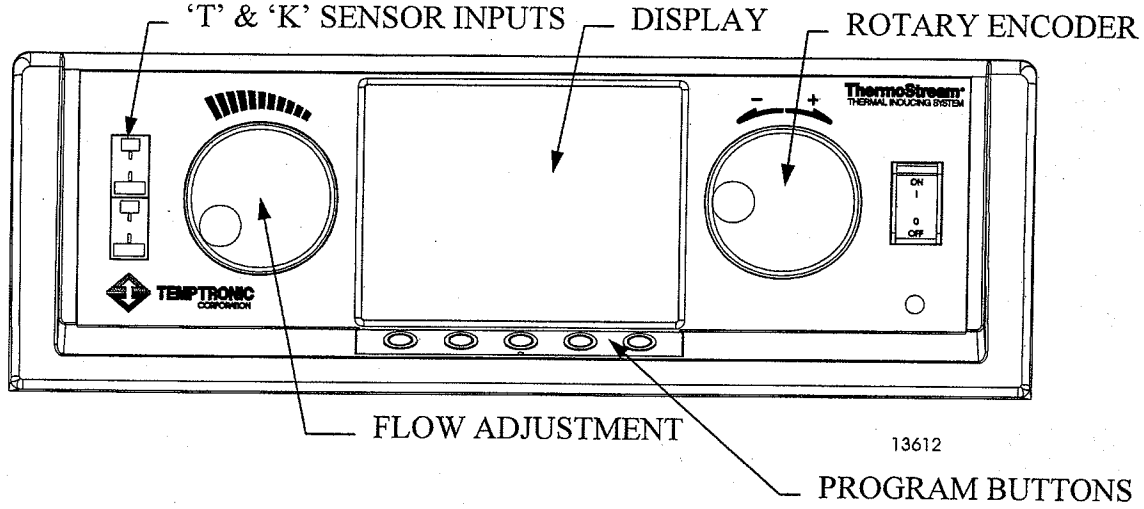

Figure 3-4 User Interface

3-7.1 Overview

The TP04100A User Interface is located on the controller cabinet front panel and has three main components (see Figure 3-4, above): 1) the Graphical Display Screen, 2) five (5) Program Buttons located below the display screen, and 3) the Rotary Encoder located to the right of the display screen.

Two additional user interface components are located to the left of the display screen: 1) the type 'T' and 'K' Device Under Test (DUT) Sensor Input sockets, and 2) the air Flow Adjustment valve.

3-7.2 Graphical Display Screen

The Graphical Display Screen, located at the center of the controller front panel, is an amber monochrome electroluminescent display, approximately 5.5 inch size in diagonal measurement. This graphical user interface provides a highly visible readout of operational information. It allows test engineers, production operators, and non-technical individuals optimum ease of use with minimum learning time.

The operational screens display the following values: active temperature, the temperature setpoints, soak times, ramp rates up and down, how many cycles are being performed and the DUT sensor selection. Additional screens facilitate programming of Test Setups, system configuration, define the limits of operation, and calibrate the system. Menu choices which correspond to various functions are displayed at the bottom of the screen, above the Program Buttons.

3-7.3 Program Buttons

There are five (5) Program Buttons in a single horizontal line below the Graphical Display Screen. These five buttons provide easy selection of the menu choices displayed along the bottom of the display screen. As the various program screens are selected, the menu choices automatically change to provide additional menu choices associated with the screen currently displayed.

3-7.4 'T' and 'K' DUT Sensor Inputs

The 'T' and 'K' DUT Sensor Inputs are located to the far left of the Graphical Display Screen, and are used with external type 'T' and type 'K' thermocouple sensors to monitor the actual temperature of the device/component being thermally tested. The application, operation and use of DUT sensors is discussed in Section 2. The verification and calibration of DUT sensors is discussed in Section 5.

3-7.5 Flow Adjustment Valve

The Flow Adjustment valve is located to the left of the Graphical Display Screen. This valve is used to vary the output compressed hot air flow from the Thermal Wand when the Hot setpoint is above +33 °C. The hot flow can be adjusted in a range of 2 to 6 Standard Cubic Feet per Minute (SCFM). Rotate the valve knob clockwise to decrease flow. Rotate the valve knob counterclockwise to increase flow.

3-7.6 Rotary Encoder

The Rotary Encoder, to the right of the Display Screen, is used to step through and change various system parameters and effectively replaces the traditional numeric keypad and enter key. The Encoder has two modes: Step Mode and Change Mode.

Mode	To Initiate	Functions	To Terminate
Step	Is active (initiated) upon entering Manual Test Setup or Program Test Setup screens. (Parameters are highlighted).	**1**. Rotate Encoder knob clockwise to cycle forward through the parameter choices. **2**. Rotate Encoder knob counterclockwise to cycle backwards through the parameter choices.	Press ESC (Escape) Program Button to exit the present program screen. No Encoder knob press is required to terminate.
Change	Press in on the Rotary Encoder knob once. (Parameter will blink).	**1**. Rotate Encoder knob clockwise to increase the parameter value. **2**. Rotate Encoder knob counterclockwise to decrease the parameter value.	Press Encoder knob once to accept the parameter change and return to Step Mode; or, press ESC (Escape) Program Button to cancel the parameter change and return to Step Mode.

Table 3-1 Rotary Encoder Operation: Step Mode and Change Mode

As given in Table 3-1, above, by rotating the encoder knob in **Step Mode**, the various system parameters that can be set and/or changed are graphically highlighted, each one in succession. A clockwise rotation moves through the parameter choices forward while a counterclockwise rotation moves backwards through the choices.

In **Change Mode**, rotating the encoder knob changes the individual system parameter selected for change. A clockwise rotation increases the parameter value while a counterclockwise rotation decreases the value.

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

3-9 System Startup Screen

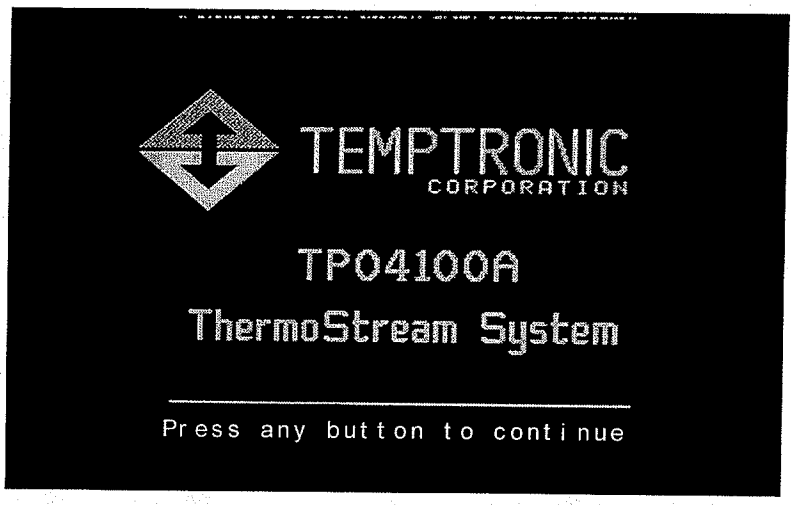

Figure 3-5 System Startup Screen

The *System Startup Screen* (see Figure 3-5, above) is displayed after the power has been turned ON. It features the Temptronic Corporation Logo and identifies the TP04100A ThermoStream System.

The system is ready for operation when the *System Startup Screen* is displayed.

Press any Program Button to continue to the *Top Menu Screen*.

If "Auto start in MANUAL OPERATION" is set to "ON" in the *Configure System Screen* (see Figure 3-16), then the system will automatically start in Manual mode, and display the *Manual Operation Screen* (see the *TP04100A Operator's Manual*).

For a flow diagram of the thirteen TP04100A screens, see the Screen Tree in Section 3-17 on page3-48.

3-10 Top Menu Screen (Program Operation Mode)

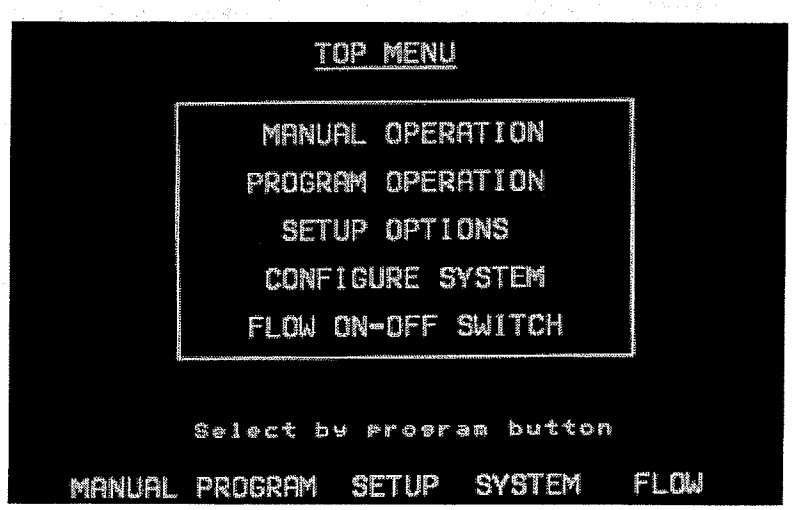

Figure 3-6 Top Menu Screen

After pressing any button on the *System Startup Screen,* the *Top Menu Screen* is displayed (see Figure 3-6, above). This screen allows immediate access to the MANUAL and PROGRAM OPERATION screens where temperature testing is performed, and allows access to the SETUP OPTIONS and SYSTEM CONFIGURATION screens.

Select FLOW to turn hot air flow to the Thermal Wand to ON or OFF (see Section 3-10.1, below).

Use the Program Buttons below the display screen to select the desired function which corresponds with each button.

If "Auto start in MANUAL OPERATION" is set to "ON" in the *Configure System Screen* (see Figure 3-16), then the system will first display the *System Startup Screen*, then go to Manual Operation mode.

The **Manual Operation** mode (see the *TP04100A Operator's Manual*) has a maximum selection of 10 unique test setups and facilitates **production run testing**. Each Manual Operation test setup includes a hot setpoint, a cold setpoint, and an ambient setpoint. Manual cycling is specifically for a three setpoint progression.

The **Program Operation** mode (see Section 3-11.2) accesses a maximum selection of 10 unique test setups, and facilitates **programmed evaluation and characterization of development devices**. Each Program Operation test setup includes 10 unique setpoints as desired (any temperature within the range of system operation), organized in any desired cycling sequence.

For the purpose of this manual, select the "Program" button to access the *Program Operation Screen,* and to operate in Program Operation mode.

The function selections at the bottom of the display screen in Figure 3-6 are summarized as follows.

3-10.1 Top Menu Screen Selections

MANUAL: This selection takes the operator to the *Manual Operations Screen* (see *TP04100A Operator's Manual)*.

PROGRAM: This selection takes the operator to the *Program Operations Screen* (see Figure 3-7 on page 3-24).

SETUP: This selection takes the operator to the *Setup Options Screen* (see Figure 3-10 on page 3-28).

SYSTEM: This selection takes the operator to the *Configure System Screen* (see Figure 3-16 on page 3-44)

FLOW: This selection allows the operator to toggle the hot air flow of the Thermal Wand ON and OFF without temperature control. The first press of the FLOW program button turns the hot air flow ON, the second press turns it OFF.

This allows the operator to verify and/or adjust system hot air flow for hot setpoint temperatures of +33.1 °C through +225 °C. Use the Flow Adjustment knob which is located to the left of the Graphical Display Screen (see Figure 3-4). The range of the Flow Adjustment Knob is 2 to 6 Standard Cubic Feet per Minute (SCFM).

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

3-11 Conducting Tests

3-11.1 Overview

In Program Operation Mode the operator can conduct tests in two temperature control modes:

1. **Main Air mode**: factory set default, which uses the main airstream temperature at the Thermal Wand nozzle outlet

2. **DUT mode:** which uses the DUT temperature as primary control, and requires a temperature sensor be interfaced directly to the DUT

Testing procedures for the two temperature control modes are presented in this section.

A test will run, however, only if its related test setup parameters have been properly preset (see Section 3-12, Setting Up Tests).

The next paragraphs describe the Program Operation mode for testing by:

1. **Cycling** from two up to 10 setpoints, by using the Cycle function on the *Program Operation Screen.*

2. **Ramping and soaking** for the cycling sequences as defined using the *Program Test Setup Screen.*

To test from a **manually selected setpoint**, using the *Manual Operation Screen,* see the *TP04100A Operator's Manual.*

As the Main Air mode 1) is factory set, and 2) the screen commands of DUT mode are variations of the default Main Air mode screen commands:

> **FAMILIARITY WITH THE DEFAULT "Air" MODE SCREENS IS RECOMMENDED BEFORE ATTEMPTING TO OPERATE IN DUT MODE.**

For a flow diagram of the thirteen TP04100A screens, see the Screen Tree in Section 3-17 on page3-48.

3-11.2 Program Operation Screen (Air Mode)

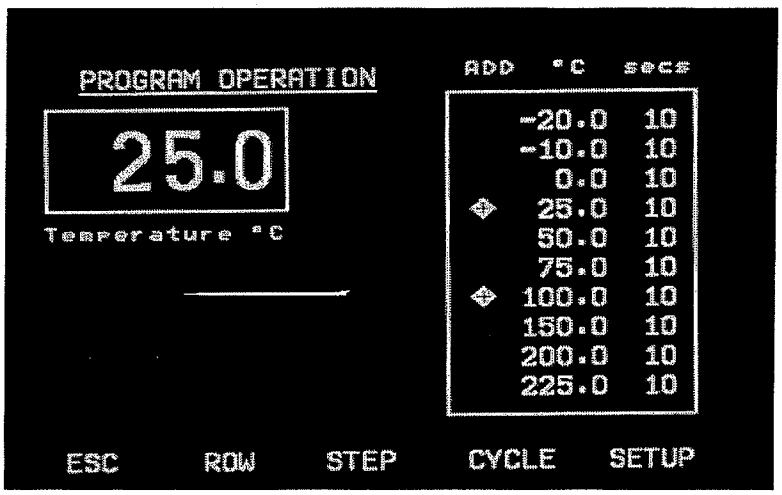

Figure 3-7 Program Operation Screen (Air Mode)

If the system is in default Air mode (which uses the main air thermocouple to control temperature), then when "Program Operation" is selected at the *Top Menu Screen* (see Figure 3-6), the User Interface displays the *Program Operation Screen: Air Mode* (see Figure 3-7).

To change modes (to either Air or DUT mode), see "Air Mode Test Setup," Section 3-13 on page 3-40, and "DUT Mode Test Setup," Section 3-14, on page 3-42.

Note that the *Program Operation Screen* displays the Air temperature, the DUT temperature (if in DUT mode or a DUT sensor type is selected and installed), displays which temperature is active, and displays the ten programmed temperature setpoints, and soak times.

The function selections at the bottom of the display screen in Figure 3-7 are summarized as follows. To execute a function, press the corresponding Program Button..

ESC: This selection returns the operator to the previous program screen, unless the system is running to a setpoint, in which instance the system stops running to the setpoint. ESC can also be used to exit the Change Mode and cancel any changes made to the selected parameter value.

ROW: This selection chooses an entire row (includes three fields: "Add," "°C," and "secs [soak]"). Press "Row" again to advance downward one row. Hold "Row" button down to transit down continuously and scroll back up to top row.

STEP: This selection sequentially steps through the three fields ("Add," "°C," and "secs") in the selected row. The active (selected) field is highlighted. Use the Rotary Encoder to change setpoints: press the Encoder knob inward to enter Change Mode (highlighted field blinks); rotate Encoder knob; at desired value, press Encoder knob inward to accept new value and exit Change Mode.

CYCLE: This selection begins temperature cycling.

The setpoints selected (included) for a program cycle are identified by the ADD symbol: a plus "+" sign inside a diamond frame. Each cycle starts by first going to the top (first) setpoint. After the soak time expires at that setpoint, the system continues "At Temperature" for the set test time, then the cycle continues to the next (second) setpoint. After the soak time and test time expires at that setpoint, the cycle continues to the next setpoint, and so on until all set test temperatures have been performed. After the soak time and test time expires at that last setpoint, provided more than one cycle has been programmed, the TP04100A will then go to the top (first) setpoint to begin the next cycle until the set number of cycles have been completed or the STOP button is pressed (see Figure 3-8, below).

Note: If system **appears to "hang"** and **not advance to next cycle step** when "At Temperature" (during "test time"), from *Program Operation Screen*, then "Stop" cycling, enter "Setup," select "Define" to display *Define Parameters Screen*, and check the "Maximum test time (sec)" setting. This sets how long, in seconds, the system will remain "At Temperature" after the soak time has elapsed, before advancing to the next cycle step. Use "Select" to select "Maximum test time (sec)," and use the Rotary Encoder to adjust the setting. To proceed to next temperature during cycling without delay, set to 0 (zero) seconds. Press "Done" to save the entire test setup, then select "Program" and press "Cycle" to resume cycling.

During cycling, a "Cycle" counter field displays the number of cycles completed, labeled "Transition" then "Soak" (seconds), then "At Temperature" (seconds) to indicate time elapsed per cycle sequence status (see Figure 3-8, below).

While the system is temperature cycling, the "Cycle" label changes from "Cycle" to "Stop" (see Figure 3-8, below). By selecting "Stop" the operator can stop both air flow and temperature cycling.

SETUP: This selection accesses the *Program Test Setup Screen* (see Figure 3-12, on page 3-33) where the operator can change setpoint values and change/select Test Setup programs.

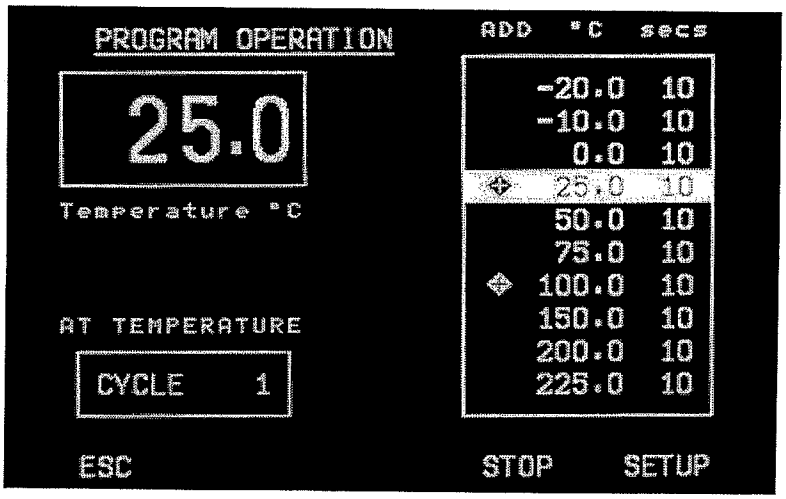

Figure 3-8 Program Operation (Air Mode): Cycling

3-11.3 Program Operation Screen (DUT Mode)

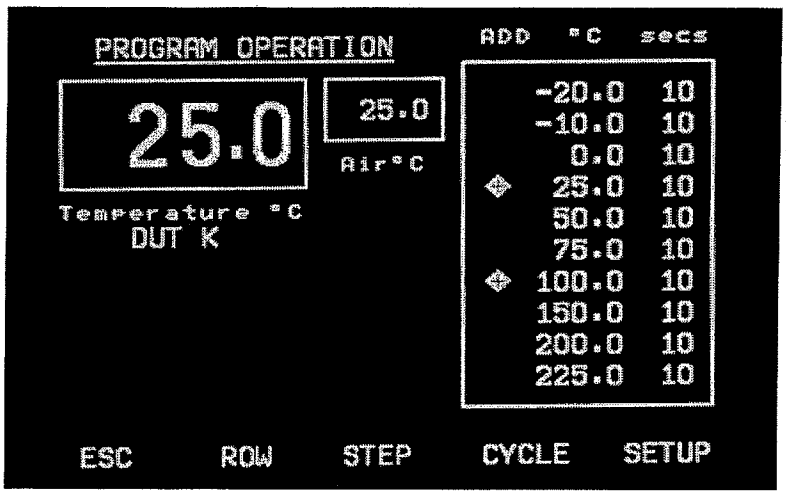

Figure 3-9 Program Operation Screen (DUT mode)

If the system is in DUT mode (which uses either a type K or type T thermocouple sensor directly attached to the DUT to control temperature), then when "Program Operation" is selected at the *Top Menu Screen*, the *Program Operation Screen: DUT Mode* (see Figure 3-9, above) is displayed.

To change modes (to either Main Air or DUT mode), see "*Define Parameters Screen*," Figure 3-11 on page 3-29, and "DUT Mode Test Setup," Section 3-14, on page 3-42).

The *Program Operation Screen: DUT Mode* allows the operator to perform all the same functions as given on the *Program Operations Screen: Air Mode*.

For a detailed explanation of each menu command: Esc, Row, Step, Cycle and Setup, see Section 3-11.2.

In the figure above, notice that the main temperature window is labeled "DUT."

Note: if the system is being controlled by a remote interface, then a DUT sensor can be selected, installed, and remotely polled, even when the system is not in DUT mode (is in Air mode). See "DUT sensor (Off, K, T) (Setup Parameter)," Section 3-12.3.3 on page 3-30.

3-12 Setting Up Tests

3-12.1 Overview

Program Operation Mode can access test setups in either of the two temperature control modes: Main Air mode or DUT mode.

A test will run, however, only if its related test setup parameters have been properly preset.

- For Main Air mode test setups, see Section 3-13 on page 3-40.
- For DUT mode test setups, see Section 3-14 on page 3-42.

Each test setup file contains the system setup parameters and temperature setpoints to allow a DUT to be tested over a ramp/cycle sequence of up to 10 temperature setpoints.

Different test setup files are programmed through the *Program Test Setup Screen* (see Figure 3-12).

By using the factory defaults, or by accessing a previously saved test setup (see *Copy Setups Screen*, Figure 3-13), a new setup can be programmed by changing the system setup parameters and the temperature setpoint parameters for a particular test.

3-12.2 Setup Options Screen

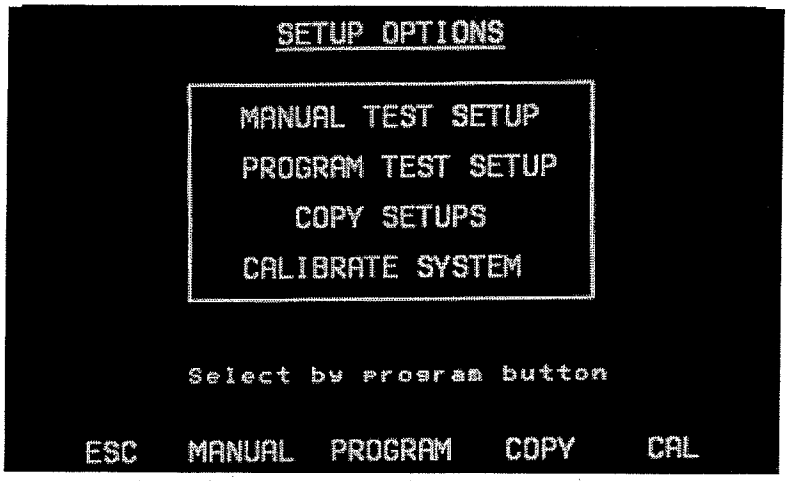

Figure 3-10 Setup Options Screen

To display the *Setup Options Screen* (see Figure 3-10), select the "Setup" Program button from the *Top Menu Screen* (see Figure 3-6).

The *Setup Options Screen* permits the operator to select "Manual" or "Program" to branch to the *Manual Test Setup Screen* or the *Program Test Setup Screen*, respectively. These screens allow the operator to change setpoint values, change/select Test Setup programs, and to set other Test Setup parameters. Select "Copy" to copy Test Setups or "CAL" to calibrate the system.

The function selections at the bottom of the display screen in Figure 3-10 are summarized as follows:

ESC: This selection returns the operator to the previous program screen.

MANUAL: This selection takes the operator to the *Manual Test Setup Screen* (see *TP04100AA Operator's Manual)*.

PROGRAM: This selection takes the operator to the *Program Test Setup Screen* (see Figure 3-12).

COPY: This selection takes the operator to the *Copy Setups Screen* (see Figure 3-13).

CAL: This selection takes the operator to the *Calibrate System Screen* (see "Calibration," Section 5).

3-12.3 Define Parameters Screen

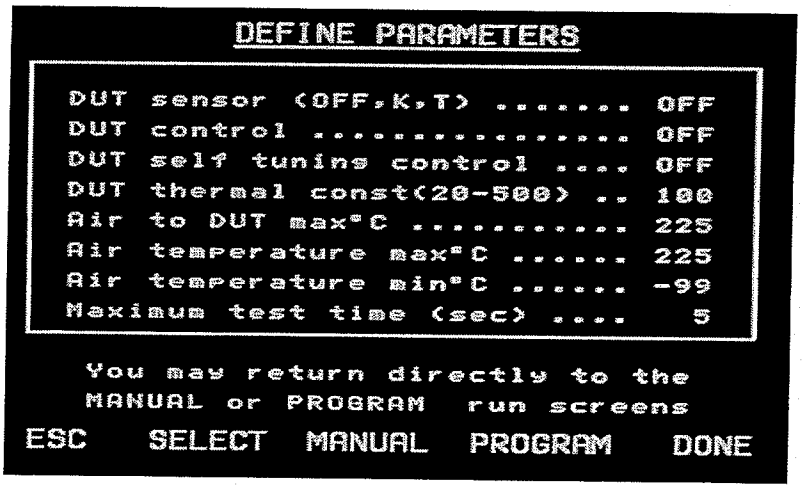

Figure 3-11 Define Parameters Screen

To access the *Define Parameters Screen*: from the *Top Menu Screen*, select the "Manual" or "Program," Program Button, then from either the *Manual Operation Screen* or *Program Operation Screen,* select the "Setup" Program Button, then from either the *Manual Test Setup Screen* or *Program Test Setup Screen*, select the "Define" Program Button.

The *Define Parameters Screen* allows the operator to define system test setup parameters, minimum and maximum air temperatures, and to set the maximum test time.

The function selections at the bottom of the display screen in Figure 3-11 are summarized as follows.

3-12.3.1 Define Parameters Screen Selections

ESC: This selection returns the operator to the previous program screen or is used to exit the Change Mode and cancel any changes made to the selected parameter value.

SELECT: This selection steps through and frames each Test Setup parameter sequentially from top to bottom. The first press selects "DUT control." The second press moves down to select "DUT sensor," and so on, down to "Maximum test time." After reaching the bottom, continued pressing of the "Select" Program Button steps through the same selections again, beginning at the top choice. Once a field is selected, use the Rotary Encoder to change the value.

MANUAL: This selection takes the operator to the *Manual Operation Screen* (see *TP04100A Operator's Manual*).

PROGRAM: This selection takes the operator to the *Program Operation Screen* (see Figure 3-7).

DONE: This selection takes the defined parameters, places them into the current Test Setup program file, then returns the operator to the *Manual Operation Screen* or *Program Operation Screen* (whichever mode was active prior to the operator entering *Define Parameters)*. That is, changes made on the *Define Parameters Screen* are global: they apply to both Manual and Program modes (see "Data Sets," Section 3-12.5.2 on page 3-36).

Each of the parameter settings on the *Define Parameters Screen* are defined as follows:

3-12.3.2 DUT sensor (Off, K, T) (Setup Parameter)

Allows the operator to select a DUT sensor type for use. When in DUT mode, a DUT sensor must be selected.

However, if the system is being controlled by a remote interface, then a DUT sensor can be selected, installed, and remotely polled, even when the system is not in DUT mode (is in Air mode).

If remotely polling the DUT in Air mode, then a) a DUT Sensor must be selected, b) "DUT self tuning" and "Air to DUT max °C" are not enabled.

- **Off:** Selects "no external DUT sensor" being used (and defaults system to Main Air mode)
- **K:** Selects the use of a DUT type K thermocouple sensor
- **T:** Selects the use of a DUT type T thermocouple sensor

3-12.3.3 DUT control (Off, On) (Setup Parameter)

Allows the operator to set system temperature control to be from one of two sources: from the main air thermocouple sensor, or from an external DUT sensor.

- **Off** - Selects the main air thermocouple sensor for system temperature control (Main Air mode).
- **On** - Selects an external thermocouple sensor for system temperature control (DUT mode). When this feature is used a DUT type K or type T sensor parameter must be selected (below), and the same type external sensor must be installed into one of the two ports located on the system front panel and properly interface to the DUT (see Section 2, "Thermocouples."

3-12.3.4 DUT self tuning control (Off, On) (Setup Parameter)

Allows the operator to enable DUT mode self tuning: an automated process which obtains the best compromise between minimal overshoot and fastest temperature transition time by measuring the thermal mass characteristics of the specific DUT against successive system supplied temperature ranges.

Applies to DUT mode operation only.

- **Off** - Disables DUT mode self tuning
- **On** - Enables DUT mode self tuning (and use of "DUT thermal constant" parameter, below)

3-12.3.5 DUT thermal constant (20-500) (Setup Parameter)

Allows the operator to fine tune the value set by self-tuning. This applies to DUT mode operation only

Accepted values are 20 to 500 in increments of 1. This number is actually a small modification factor applied to the system tuned (derived) PID (Proportional Integral Derivative) constants.

Since the DUT mode self-tuning routine derives optimum PID constants, the DUT thermal constant allows the operator to over dampen or under dampen device temperature response.

The thermal constant mid-range (default setting) is 100: values lower than 100 are for under damping device response and values higher than 100 are for over damping device response. Therefore this number is used as a way of tuning the system to the thermal time response of the user's specific device type.

The constant can be set to produce minimum over-shoot/maximum stability/slower time to temperature, or set for moderate overshoot/moderate stability/faster time to temperature. These varying traits of temperature control are up to the user.

When setting, use this simple rule of thumb: the larger the DUT thermal constant, the greater is the damping; the lower the DUT thermal constant, the smaller is the damping.

3-12.3.6 Air-to-DUT max difference (°C) (Setup Parameter)

Allows the operator to set a maximum limit on the difference between the air and DUT temperatures that will occur when operating the system in "DUT control" mode.

Accepted values are any between 10 °C and 225 °C in 1 °C increments. When the system is shipped this value is set to 225 °C to ensure minimum transition times between temperatures.

The software applies this value symmetrically as the maximum allowable temperature differential between the air temperature and DUT temperature as read by the system. It will apply either in a positive or negative manner depending on the direction of control for the DUT.

For example, if "Air-to-DUT max difference" is set to 10 °C, and the device is currently at 50 °C, and a setpoint of 100 °C is selected, then the air temperature would only be allowed to drive 10 °C maximum above the current DUT temperature.

Inversely, if a setpoint of +25 °C is selected, and the device is currently at +50 °C, the air temperature would only be allowed to drive 10 °C maximum below the current DUT temperature.

Important: note that this "Air-to-DUT max difference" feature works in coincidence with the "Air temperature max" **upper** and "Air temperature min" **lower temperature limits** which continue to define the upper and lower air temperature limits.

For example, if the upper temperature limit is set to +150 °C, and the "Air-to-DUT max difference" is set to 20 °C, and the device is currently set at +140 °C, and a setpoint of +150 °C is selected, then the air temperature would only be allowed to drive 10 °C maximum above the current DUT temperature to the upper limit of +150 °C.. Thus the DUT may not achieve, or may take a long time to achieve, the desired setpoint.

3-12.3.7 Air temperature max (°C) (Setup Parameter)

Allows the operator to set the maximum limit (or hottest) hot air temperature which the DUT will undergo when the system is controlling in DUT mode.

Accepted values are any temperature between +25 °C and +225 °C in 1 °C increments. When the system is shipped this value is set to the system's upper air limit of +225 °C.

3-12.3.8 Air temperature min (°C) (Setup Parameter)

Allows the operator to set the minimum limit (or coldest) cold air temperature which the DUT will undergo when system is controlling in DUT mode.

Accepted values are any temperature from -99 °C to +25 °C in 1 °C increments. When the system is shipped this value is set to -99 °C to ensure that the maximum system cooling capability is not hindered. However, setting below system range can cause overshoot in DUT control mode.

3-12.3.9 Maximum test time (seconds) (Setup Parameter)

Allows the operator to program a maximum test time, acting as a timer.

This timer begins automatically at the end of any programmed soak time when the "AT TEMPERATURE" condition is reached and the "start test" signal is given by the system. This is primarily useful when using the ramp/cycle mode of system operation, but it has other valid uses, described below.

Because the system is capable of being coupled with automatic test equipment utilizing standard "start test" (ST) and "end of test" (EOT) signals, this feature can work in two ways:

First, it allows simple operation utilizing only the "start test" signal from the system to the host tester. If the "end of test" signal is not available from the host tester, or is not used, then when the test time has elapsed, the system automatically moves to the next temperature setpoint in the cycle routine.

Second, if the "end of test" signal is being used, then this "maximum test time" feature can prevent the system from "hanging up" (interrupting the cycling routine) in the instance of the "end of test" signal not being properly received from the host tester.

For example, if the operator programs a cycling routine of 10 temperature setpoints, each with varying test time lengths, with the longest setpoint time test being 5 seconds, then you might set "maximum test time" to 6 seconds. In this way, if the "end of test" signal is not properly received by the system, the system will still automatically cycle to the next setpoint after 6 seconds and not "hang up."

To disable or ignore "maximum test time," set it to 0 (zero).

3-12.4 Program Test Setup Screen

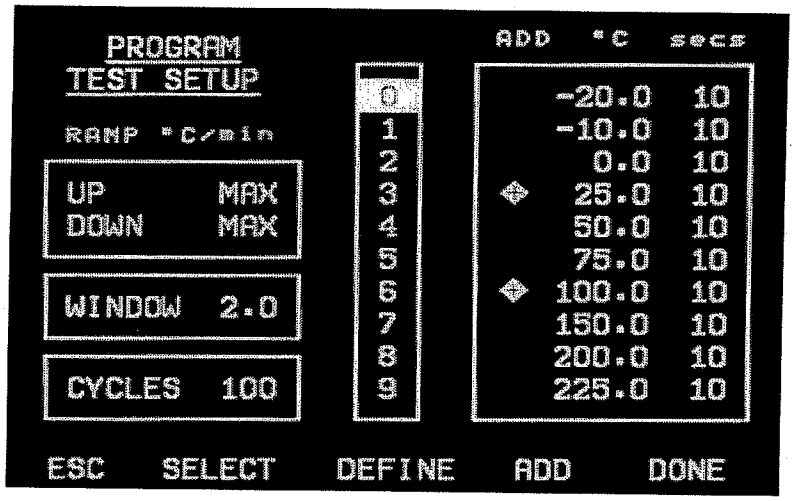

Figure 3-12 Program Test Setup Screen

To access the *Program Test Setup Screen* (see Figure 3-12, above): from either the *Top Menu Screen* or *Setup Options Screen*, select the Program Button under "Program," then from the *Program Operation Screen*, select the "Setup" Program Button.

Note, that if the *Manual Test Setup Screen* is selected, then only three setpoints will be displayed: Hot, Ambient, and Cold (see the *TP04100A Operator's Manual)*. To change from Manual mode to Program mode, press ESC twice to access the *Top Menu Screen*, then follow the instructions in the first paragraph of this section to access the *Program Test Setup Screen.*

The *Program Test Setup Screen* consists of five program button functions and five windows:

- Functions: ESC, SELECT, DEFINE, ADD, DONE (press button below function to execute)
- Ramp "UP/DOWN" Fields
- Temperature Band: "WINDOW"
- Number of "CYCLES"
- Test Setups: "0 - 9"
- Setpoints (per Test Setup): "Add," "°C," "Secs (Soak Time, Seconds)"

Use the Rotary Encoder (see Table 3-1) to navigate the five windows (except "Test Setups 0-9," which uses the "Select" program button) as follows: rotate Encoder knob to highlight the desired field, then, to change setpoints, press Encoder knob inward to enter Change Mode (highlighted field blinks); rotate Encoder knob; at desired value, press Encoder knob inward to accept new value and exit Change Mode.

The function selections at the bottom of the display screen in Figure 3-12 are summarized as follows.

3-12.4.1 Program Test Setup Screen Selections (Functions)

ESC: This selection returns the operator to the previous program screen or is used to exit the Change Mode and cancel any changes made to the selected parameter value.

SELECT: This selection steps through (highlights) the Test Setups programs "0" through "9." The first press highlights the "0" Test Setup program. The second press highlights the "1" Test Setup, and so on, down to "9" Test Setup. After reaching "9," continued pressing of the "Select" Program Button steps through the same choices, beginning at "0" Test Setup. As each Test Setup is highlighted, the displayed program parameter values automatically change to show the values stored in memory for the highlighted Test Setup program.

DEFINE: This selection takes the operator to the *Define Parameters Screen* (see Figure 3-11)

ADD (to cycling): This selection allows the operator to add or delete the related temperature setpoint and soak time to the cycling sequence by flagging the setpoint with a (diamond) marker in the "Add" field (see Figure 3-12). Use the Rotary Encoder to highlight the desired "Add" field, then select the "Add" Program Button (on bottom of the display screen) to toggle the field to either flagged (with a marker) or not-flagged (no marker, field is empty). Cycling proceeds sequentially, from top flagged setpoint, downward, to bottom flagged setpoint. Unflagged setpoints are not cycled.

DONE: This selection takes the current (highlighted) Test Setup program, places it into the "0" Test Setup program location (see Section 3-12.5.1 on page 3-36), then returns the operator to the *Program Operation Screen* (see Figure 3-9). The program parameter values used on the *Program Operation Screen* are always values stored in the "0" Test Setup program.

Each of the five windows on the *Program Test Setup Screen* are summarized as follows.

3-12.4.2 Temperature Band "WINDOW""

The temperature band "Window" displays the temperature band (range) above and below (plus or minus) the setpoint that is considered to be "at temperature." The factory set default value is ±2.0 °C. Use the Rotary Encoder to select and change temperature band "Window" values.

3-12.4.3 Number of "CYCLES"

Allows the operator to set from 1 to 999 temperature cycles to be performed by the system. During cycling, the number of completed cycles is displayed on the *Program Operation Screen (Cycle Mode)* (see Figure 3-8). For a detailed explanation of system cycling, see *Program Operation Screen*, "Cycle" topic, on page 3-25. Use the Rotary Encoder to select and set the number of cycles.

3-12.4.4 Test Setups: "0 - 9"

Use the "Select" Program Button (described in Section 3-12.4.1, above) to highlight a desired test Setup, selecting from the ten Setups numbered 0 through 9. Once highlighted, the Setup's related setpoints (described in Section 3-12.4.5, below) can be modified. As each Setup is highlighted, the display changes to show the related setpoints specific to the highlighted Setup. For a detailed explanation of Test Setup **Data Sets**, and **Default Test Setup "0,"** see Section 3-12.5 on page 3-36.

3-12.4.5 Setpoints (per Test Setup): "Add (Cycling)," "°C," "Secs (Soak Time)"

Each of the ten Test Setups "0 - 9" has, in turn, a maximum of ten setpoints. Each setpoint consists of three values (or fields), given below.

- **ADD (to cycling)**: Allows the operator to add or delete the related temperature setpoint and soak time to the cycling sequence (see "ADD (to cycling)" topic, above, in Section 3-12.4.1).
- **°C:** Allows the operator to program a temperature setpoint within the temperature range of the system (-20 °C to +225 °C). Use the Rotary Encoder to select and set the °C value. Note: programming a cold setpoint below system lowest range (-20 °C) can cause Cycle mode to "hang" (to not advance).
- **Secs (Soak Time, seconds):** Allows the operator to program a soak time in seconds. During cycling, when the system achieves setpoint, the DUT is first "soaked" at the setpoint temperature for the soak time specified in this field, after which the system is "At Temperature" and sends a "Start Test" signal to the tester station. Use the Rotary Encoder to select and set the seconds value. See "Maximum test time (seconds)" (in Section 3-12.3.9 on page 3-32) to prevent cycling from becoming "hung" (stalled) if no "End of Test" signal is received from the tester station.

3-12.4.6 Ramp "UP/DOWN" Fields

Allows the operator to program a Ramp rate value in °C/minute, which is the rate of incremental temperature increase or decrease, beginning from the current temperature and proceeding to the setpoint temperature. The higher the Ramp rate setting, the greater (faster) is the Ramp rate. The lower the Ramp rate setting, the less (slower) is the Ramp rate.

Use Rotary Encoder to select and set Ramp rates. At highest or lowest value, reverse direction of Encoder rotation to go back to lower or higher values.

- **UP (MAX, 1 to 999):** Sets hot (increasing temperature) Ramp rate. "MAX" is fastest UP Ramp rate.
- **DOWN (MAX, 1 to 999):** Sets cold (decreasing temperature) Ramp rate. "MAX" is fastest DOWN Ramp rate.

3-12.5 Default "0" Setup, Three Data Sets per Setup

3-12.5.1 Default "0" (Zero) Test Setup

Test Setup "0," referred to as "Default '0' Test Setup," is **always the active test when the system is running,** and is the Test Setup to which the system defaults when the system is initially turned on.

That is, all values in Test Setup program "0" are replaced by the new values from any of the other nine Test Setups (1 to 9) when one of them is selected to run.

Any changes made to any Setup values are automatically saved into the default, "0" Test Setup program.

Saved values are retained in Test Setup "0" even if the system is turned off.

Similarly, any changes made to any active setpoint temperature or system parameter value are stored in this default, Test Setup "0" program.

When an active Setup setpoint is being changed, the system maintains temperature control at the old setpoint value until the new setpoint value is entered by pressing in on the Rotary Encoder knob (see Table 3-1). Once entered, the system controls at this new setpoint value.

To save the current Default "0" Test setup by copying it into (overwriting) another Setup, or to replace the current "0" Setup with one of the other nine Test Setups (1 to 9) see *Copy Setup Screen,* Figure 3-13.

3-12.5.2 Data Sets Per Setup: Manual, Program, Defined Parameters

The ten Test Setups "0-9" are accessed and setup on the *Program Test Setup Screen* (see Figure 3-12), are run from the *Program Operations Screen* (see Figure 3-7), and can be copied from one numbered Setup into another using the *Copy Setup Screen* (see Figure 3-13).

Each of the ten Test Setups contains multiple data sets, as follows:

DATA SET	TEST SETUPS 0 - 9
Manual Mode	Hot, Ambient, Cold Setpoints (see the *TP04100A Operator's Manual)*
Program Mode	Ramp, Cycle, up to ten Setpoints / Setup (see the *Program Test Setup Screen)*
Defined Parameters	DUT mode parameters; Air to DUT max °C, Minimum & maximum air temperatures; Maximum test times "At Temperature" (see the *Define Parameters Screen)*

Table 3-2 Test Setups Data Sets: Manual, Program, Defined Parameters

Therefore, each Test Setup 0 - 9 contains Manual mode data, Program mode data, and a common set of Defined Parameters data.

Changing a Test Setup only changes that (active) Test Setup mode: it does not change Setups in other modes and does not change the common Defined Parameters. For example, changes to a Program mode Test Setup do not change the Manual mode Test Setup saved in the same numbered Setup.

Changing the Defined Parameters, however, applies to both Program and Manual mode Test Setups.

Copying one Setup (source) into another Setup (destination) copies (and overwrites) all three data sets (Manual, Program, Defined Parameters) from the source into the destination (see the *Copy Setup Screen,* Figure 3-13).

3-12.6 Copy Setup Screen

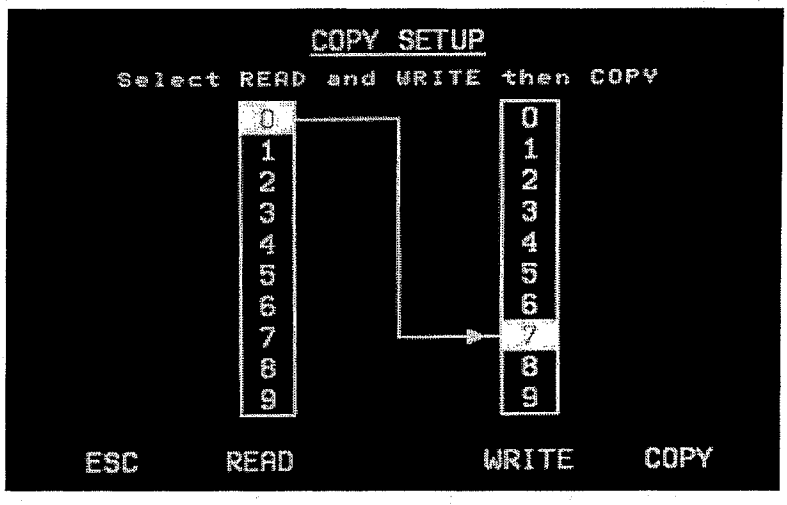

Figure 3-13 Copy (Test) Setup Screen

Access the *Copy Setup Screen* as follows: from the *Top Menu Screen* select the "Setup" Program Button, then from the *Setup Options Screen*, select the "Copy" Program Button.

The *Copy Setup Screen* (see Figure 3-13, above) allows the operator to copy any of the ten Test Setups (0 through 9) which were setup on the *Program Test Setup Screen* (see Figure 3-12) into any other Test Setup location.

This includes saving the active Default "0" Test Setup by copying it into (overwriting) another Setup (one numbered 1 through 9), or to replace the current "0" Setup by overwriting it with one of the other nine Test Setups (1 to 9).

Copying one Setup (source) into another Setup (destination) copies all three data sets (Manual, Program, Defined Parameters) from the source Setup into the destination, and erases (overwrites) the destination Setup.

Default "0" Test Setup (from which all tests are conducted), and the three Data Sets which comprise Setups "0 to 9," are explained in detail on page 3-36 and page 3-37.

The function selections at the bottom of the display screen in Figure 3-13 are summarized as follows:

ESC: This selection returns the operator to the previous program screen or (if COPY has not first been pressed) is used to exit the Change Mode and cancel any changes made to the selected parameter value.

READ (Source): This selection is used to step downward through Test Setups "0 - 9" and selects the source Test Setup to be copied. An arrow points from the source to destination. Hold "Read" Program Button down to scroll through source Setups "0 - 9."

WRITE (Destination): This selection is used to step downward through Test Setups "0 - 9" and selects the destination where the source Setup will be copied (written to). An arrow points from the source to destination. Hold the "Write" Program Button down to scroll through destination Setups "0 - 9."

COPY (Execute): This selection is used to overwrite (erase) the destination Setup with the source Setup. When "Copy" is pressed, "Done" appears momentarily on the screen. To retain the original source Setups, and to exit without copying, press ESC.

3-13 Main Air Mode Test Setup

3-13.1 Overview

Main Air mode is the default operating mode and uses the main air stream temperature at the Thermal Wand outlet for temperature control.

Following is a setup for Main Air mode. See the *Define Parameters Screen* for detailed explanations of each parameter.

Once parameters are defined, then use the *Program Operation Screen* to conduct the tests first setup on the *Program Test Setup Screen.*

For a flow diagram of the thirteen TP04100A screens, see the Screen Tree in Section 3-17 on page3-48.

3-13.2 Define Parameters (Air Mode, Test Setup)

Define Parameters (DUT Mode)	SET TO
DUT Control	OFF [Off, On]
DUT Sensor	OFF [Off, On]
DUT self Tuning control	ON [Off, On]
DUT Thermal Constant (20-500)	100 [20 to 500]
Air-to-DUT max (°C)	225 [10 to 225]
Air temperature max (°C)	225 [25 to 225]
Air temperature min (°C)	-20 [+25 to -99]
Maximum test time (seconds)	5 [0 to 9,999]

Table 3-3 Define Parameters (Air Mode, Test Setup))

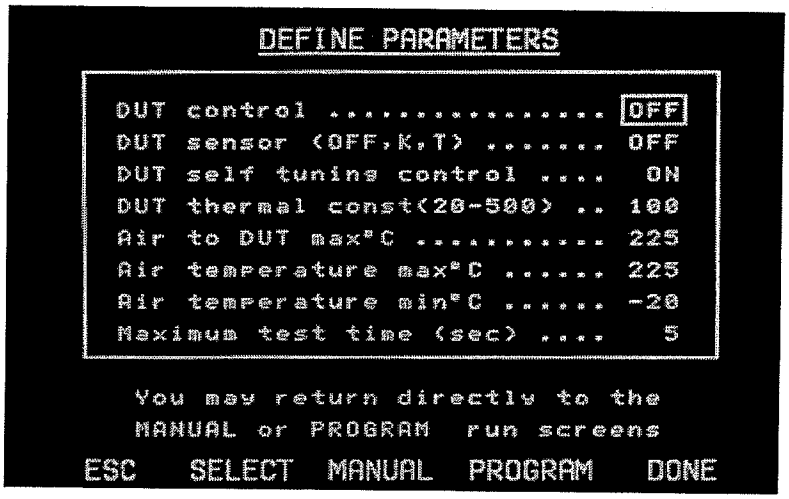

Figure 3-14 Define Parameters Screen (Air Mode, Test Setup)

3-14 DUT Mode Test Setup

3-14.1 Overview

DUT mode requires the user to install an external thermocouple sensor directly to the DUT to control temperature. See Section 2 for guidelines on attaching thermocouples to DUTs. See Section 5, "Thermocouple Input Access" for locations of thermocouple receptacles.

To optimize testing in DUT mode, and to set up the fastest possible temperature transition times while minimizing the amount of undershoot and overshoot, see "DUT self Tuning control," Section 3-12.3.4, on page 3-30.

Following is a setup for DUT mode. See the *Define Parameters Screen* for detailed explanations of each parameter.

Once parameters are defined, then use the *Program Operation Screen* to conduct the tests first setup on the *Program Test Setups Screen.*

For a flow diagram of the thirteen TP04100A screens, see the Screen Tree in Section 3-17 on page3-48.

3-14.2 Define Parameters (DUT Mode, Test Setup)

Define Parameters (DUT Mode)	SET TO
DUT Control	ON [Off, On]
DUT Sensor	K [Off, K, T]
DUT Self Tuning Control	ON [Off, On]
DUT Thermal Constant (20-500)	100 [20 to 500]
Air-to-DUT max (°C)	225 [10 to 225]
Air temperature max (°C)	225 [25 to 225]
Air temperature min (°C)	-20 [+25 to -99]
Maximum test time (seconds)	60 [0 to 9,999]

Table 3-4 Define Parameters (DUT Mode, Test Setup)

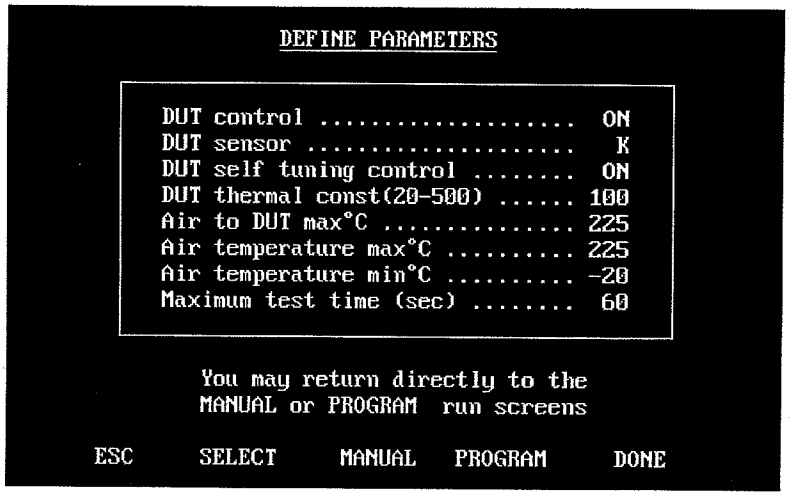

Figure 3-15 Define Parameters Screen (DUT Mode, Type K, Test Setup)

3-15 Configure System

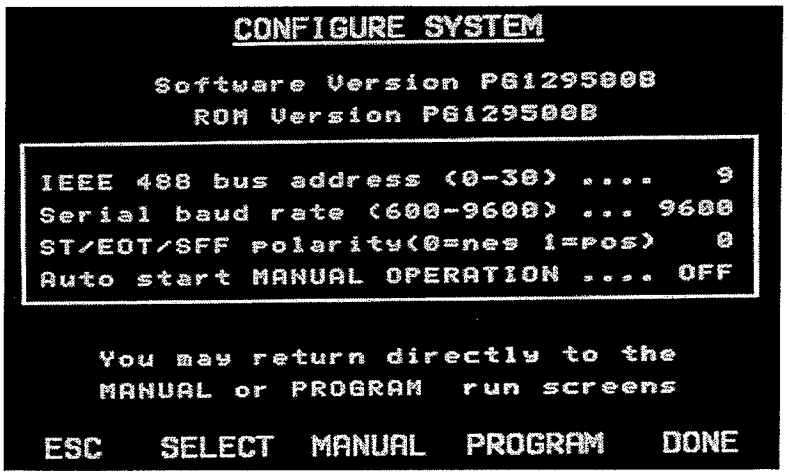

Figure 3-16 Configure System Screen

Access the *Configure System Screen* as follows: from the *Top Menu Screen* (see Figure 3-6), select the "System" Program Button.

The *Configure System Screen* (see Figure 3-16), lists the programmable options that affect the overall system operation. These options will rarely need to be changed once the system is initially set up. Note that the both the system software and system ROM versions are identified at the top of the screen.

The function selections at the bottom of the display screen in Figure 3-16 are summarized as follows.

3-15.1 Configure System Screen Selections (Functions)

ESC: This selection returns the operator to the previous program screen or is used to exit the Change Mode and cancel any changes made to the selected parameter value.

SELECT: This selection steps through (and frames) the four configurable fields from "IEEE Bus" through "Auto Start." The first press selects the "IEEE Bus" field. The second press selects the "Serial Baud Rate" field, and so on, down to the "Auto Start" field. After reaching "Auto Start," continued pressing of the "Select" Program Button steps through the same choices, beginning at "IEEE Bus" field. Use the Rotary Encoder to change values.

MANUAL: This selection takes the operator to the *Manual Operation Screen* (see *TP04100A Operator's Manual*).

PROGRAM: This selection takes the operator to the *Program Operation Screen* (see Figure 3-7).

DONE: This selection accepts (saves) the configured parameters, then returns the operator to the *Manual Operation Screen* or *Program Operation Screen* (whichever mode was active prior to the operator entering the *Configure System Screen).*

The configurable fields are as follows, selected by using the "Select" Program Button and Rotary Encoder:

3-15.2 IEEE interface bus address (0-30)

Allows the system address to be set from 0 to 30 as specified by the IEEE-488.2 standard. The system is shipped with the factory entered address "9". See Section 4.

3-15.3 Serial baud rate (600 - 9600)

Allows the system baud rate to be set from 600 to 9600. Accepted values are: 600, 1200, 2400, 4800, or 9600. The system is shipped with the factory set rate at 9600 baud. The number of data bits is fixed at 8, with no parity bit, and one stop bit.

3-15.4 ST/EOT/SFF Polarity (0 = neg, 1 = pos)

Allows the operator to change the polarity of the Start-Test, End-of-Test, and Stop-on-First-Fail signals sent and received by the TP04100A.

0 = neg: Sets all signals to negative polarity, see Section 4. This is the default setting when shipped.

1 = pos: Sets all signals to positive polarity, see Section 4.

3-15.5 Auto start (in) MANUAL OPERATION

Determines mode of operation used at system power up.

ON: Causes the system to begin in Manual Operation mode. First display is the *Manual Operation Screen* (see the *TP04100A Operator's Manual),* from which the *Top Menu Screen* is available by selecting ESC.

OFF: Causes the system to begin at the *System Startup Screen,* in Program Operation Mode. Pressing any key then displays the *Top Menu Screen.* This is the default setting when the system is shipped.

3-16 Error Messages

Major system faults are identified to the operator on the display screen as error messages.

Following is a list of the error messages and the recommended corrective actions.

Provided proper corrective action has been undertaken, pressing the ESC key clears the error.

3-16.1 Overheat

The airstream thermocouple sensor has detected an over-temperature condition and the heater has been automatically shut down. Press the [ESC] key once to try to clear the error condition. If the overheat error persists, turn the TP04100A off, wait one minute, and turn it on again. If the error still reoccurs, turn the system off and refer to the system service manual or contact the Temptronic Corporation service department. See Section 2, "Overheat Safety," regarding SF1 and SF2 safety sensors, including how to reset them.

3-16.2 Air Open Loop

The airstream temperature is not properly being read and/or controlled by the TP04100A. Press the [ESC] key to try to clear the error condition. If the air open loop error persists, turn the TP04100A off, wait one minute, and turn it on again. If the error still reoccurs, turn the system off and refer to the system service manual or contact the Temptronic Corporation service department.

3-16.3 Air Sensor Open

Temperature is not being properly read by the Main Air sensor. Check to see that the sensor is plugged in and is not open. Press ESC to clear error. If the error condition persists after attempting corrective action, turn the TP04100A off, and then refer to the system service manual or contact Temptronic Corporation service department.

3-16.4 Low Air Flow

The air flow rate is insufficient. Use the Flow Adjustment Valve located on the front panel to increase air flow. Press ESC to clear the error condition. If error condition persists, then check air pressure of air supply to the system. If error condition persists, then refer to TP04100A system service manual or contact Temptronic Corporation service department.

3-16.5 No Line Sense Error (Power Sense)

Internal hardware error: system is not properly sensing electric line power. Turn power off and restart system. If problem persists, turn off system and either see system service manual or contact the Temptronic Corporation service department.

3-16.6 NVRAM Error (Non Volatile RAM)

A non-volatile RAM error condition can cause loss of Calibration values and cause the *Configure System Screen* values to revert to default settings: "IEEE Bus Address" = 9; "Serial Baud Rate" = 9,600; "MCT Pulse Polarity" = 0 (negative); "Auto Start MANUAL MODE" = Off.

Turn off power, then restart system. If error clears, then recalibrate system and reset *Configure System Screen* values. If error does not clear, then see system service manual or contact the Temptronic Corporation service department.

3-16.7 BRAM Failure (Battery RAM)

A battery RAM failure condition can corrupt Test Setups. Turn off power, then restart system. If error clears, then reset Test Setups using *Program Test Setup Screen*. If error does not clear, then see system service manual or contact the Temptronic Corporation service department.

3-16.8 DUT Sensor Open

Temperature is not properly being read by the DUT sensor. Check to see that the sensor selected on the *Define Parameters Screen* (either Type K or Type T) is the one plugged into the TP04100A, and is not open.

Press ESC to temporarily clear error, and allow time to replug sensors, and/or to navigate to the *Define Parameters Screen* and to change "DUT sensor" type or deselect DUT mode. Press ESC to clear error. If the error persists after attempting the corrective measures described above, turn the system off, and then refer to the system service manual or contact the Temptronic Corporation service department.

3-17 Screen Tree Flow Diagram (Thirteen Screens)

A flow diagram Screen Tree of the thirteen TP04100A screens is appended to Section Three (see Drawing LMS131320), immediately following this subsection.

The screens are given below in Table 3-5, in alphabetic order, with their Screen Tree number (see Drawing LMS131320) in parentheses, and with cross references to specific manual pages.

Screen Title (Screen Tree Number)	See Manual Page
Calibration Cold (Screen 10)	Section 5, "Calibrate System"
Calibration Complete (Screen 12)	Section 5, "Calibrate System"
Calibration Hot (Screen 11)	Section 5, "Calibrate System"
Configure System (Screen 06)	Figure 3-16 on page 3-44
Copy Setup (Screen 13)	Figure 3-13 on page 3-38
Define Parameters (Screen 09)	Figure 3-11 on page 3-29
Manual Operation (Screen 03)	See *TP04100A Operator's Manual*
Manual Test Setup (Screen 07)	See *TP04100A Operator's Manual*
Program Operation (Screen 04)	Figure 3-7 on page 3-24
Program Test Setup (Screen 08)	Figure 3-12 on page 3-33
Setup Options (Screen 05)	Figure 3-10 on page 3-28
System Startup (Screen 01)	Figure 3-5 on page 3-19
Top Menu (Screen 02)	Figure 3-6 on page 3-20

Table 3-5 Screen Tree Flow Diagram (Thirteen Screens)

4- Remote Interfaces

4-1 Contents

4-2 Figures

4-3 Tables

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

4-4 Introduction

The TP04100A ThermoStream system provides three I/Os for three different communication interfaces: Serial (RS232C), Parallel Bus (IEEE-488.2), and ST/EOT/SFF Interface. The system must be configured by the operator for the specific interface to be used. This is done using the *Configure System Screen* (see Figure 4-1, below, and Section 3, "Configure System") which is accessed from the *Top Menu Screen* (see Section 3).

Note: ThermoComm Software (optional) allows the user to interface with most Temptronic Thermal Systems. It enables a) remote control, in either serial RS232C mode or parallel bus IEEE-488.2 mode, b) unattended data logging of runtime tests, c) saving and then analyzing the logged data. For details, see Section 2, "Remote Control Communications."

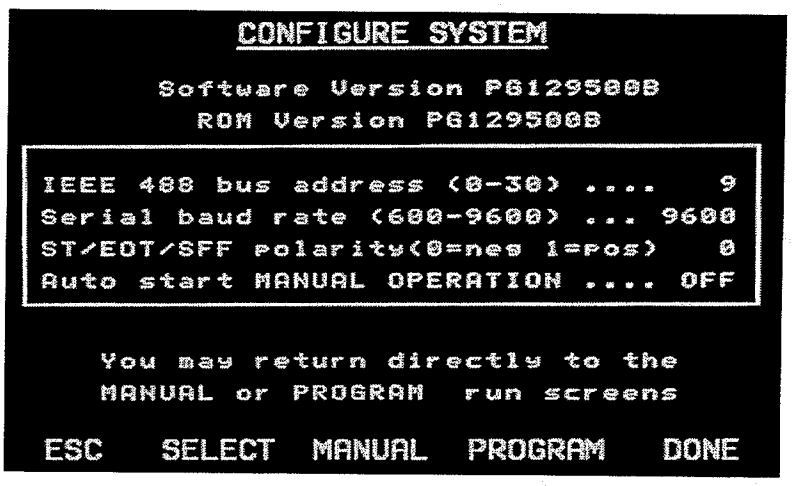

Figure 4-1 Configure System Screen

Becoming familiar with the specifications and standards of the chosen interface is required for a successful interface. The following sections provide only that information specific to the TP04100A system and identifies which commands are supported.

NOTE: The system must be in an operating mode capable of temperature control before remote control can be exercised.

When a TP04100A system is to be integrated into an automated test station the following system configuration selections must be properly set to permit control by the host.

- "Auto start MANUAL OPERATION" must be set to "On" so that the system can automatically resume operation without operator intervention after a power failure. The system will return to Manual Operation Mode when a *RST is received.

- The IEEE interface bus address or the Serial interface baud rate must be properly set.

4-5 Serial Interface

4-5.1 Serial Interface Connector

The system rear panel provides a standard DB9P (9-pin male) connector, see Table 4-1, below.

Table 4-1 Serial Interface Connector Pin Designations

Pin Number	Function/Signal Level
Shell	Chassis ground
3	Serial data out
2	Serial data in
7	
8	
6	
5	Signal ground
4	
1	
9	

The system serial interface does not support hardwire handshaking.

NOTE: Ensure not to overflow the 250 byte input buffer when using this configuration.

4-5.2 Serial Interface Parameters

A number of parameters are associated with the serial interface, see Table 4-2, below. The data bits, parity, and stop bits are fixed. Set the baud rate using the *Configure System Screen* (see Section 3).

Table 4-2 Serial Communication Parameters

Parameters	Definitions
Baud Rate	600, 1200, 2400, 4800, or 9600 baud
Data Bits	Fixed at 8
Parity	Fixed at No Parity
Stop Bits	Fixed at One (1)

4-6 Parallel Bus Interface

The IEEE-488.2 interface requires an address be assigned for each device on the bus. Set device addresses using the *Configure System Screen* (see Section 3).

4-7 Start Test [ST]/ End of Test [EOT]/ Stop on First Fail [SFF]

This interface is three solid state relay (SSR) closures: 1 closure to start test, 1 closure to end test, and 1 closure for stop on first failure (see Figure 4-2, below). Set input and output pulse polarity using the *Configure System Screen* (see Section 3).

The connector pinout is provided in Table 4-3.

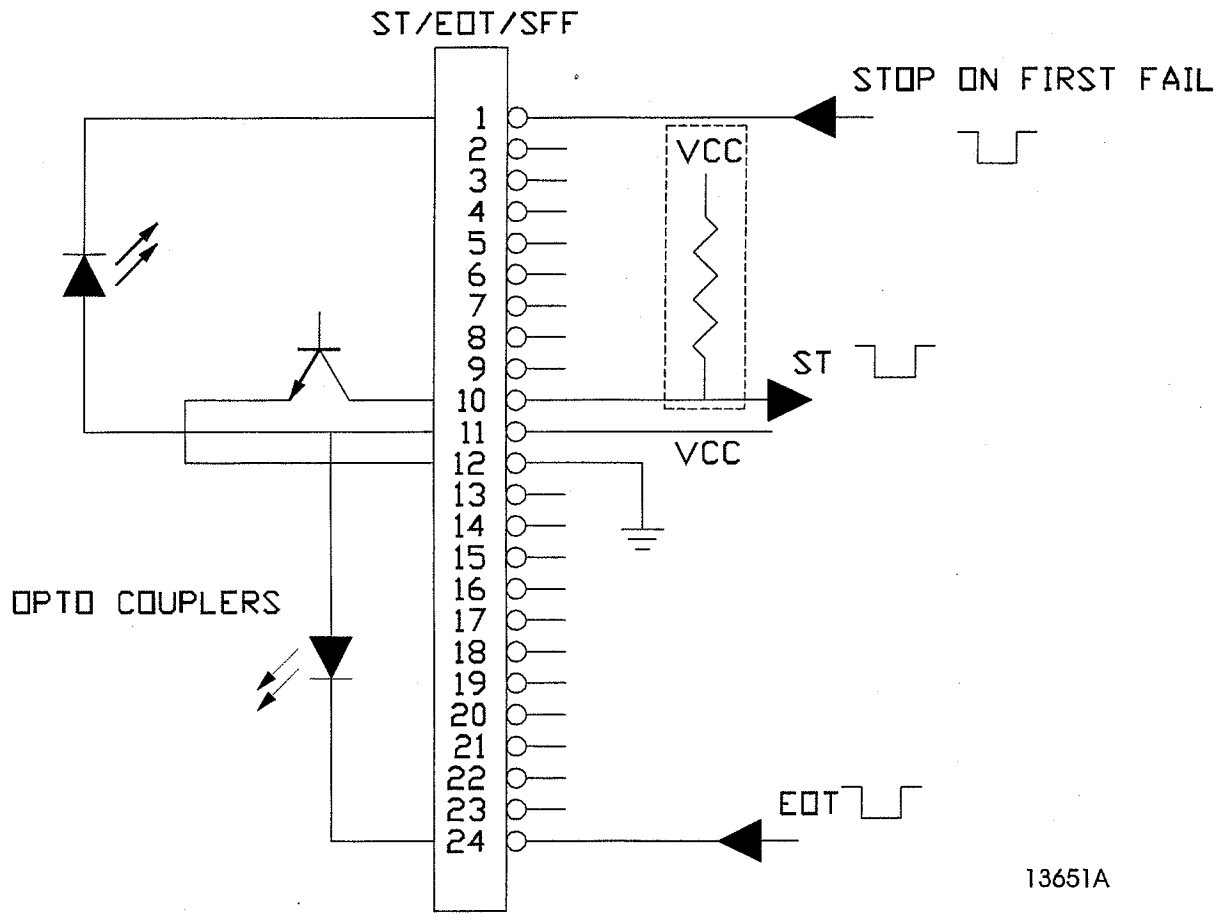

Figure 4-2 ST/EOT/SFF Interface

Table 4-3 ST/EOT/SFF Interface Connector Pin Designations

Pin No.	Signals	Functions
1	STOP ON FIRST FAIL (TEST FAILED)	An input (as short as 11 msec pulse) to the ThermoStream to signal the system (when in cycle mode) to abort temperature cycling and display "TEST FAILED"
10	START TEST (READY TO TEST)	An output (120 to 150 msec pulse) from the ThermoStream to signal the AT TEMP condition.
11	TESTER VCC	+5 to +12 Vdc
12	TESTER GROUND	Ground
24	END OF TEST	An input (as short as 11 msec pulse) to the ThermoStream to signal the system (when in cycle mode) to bypass the maximum set test time and to send the system to the next temperature setpoint in the system.

The part number for the connector supplied on the system rear panel is Molex 70716-1012 (or equal); the user must obtain and supply the mating connector.

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

4-8 Host Interface Commands

The Temptronic TP04100A ThermoStream System host interface instruction set was designed to be in substantial compliance with IEEE Standard 488.2-1987 ("IEEE Standard Codes, Formats, Protocols, and Common Commands For Use with ANSI/IEEE Std.488.2-1987 IEEE Standard Digital Interface for Programmable Instrumentation"). Please refer to that standard for general programming information.

With a few exceptions the IEEE-488.2 and serial versions of the TP04100A host interface use the same instructions.

Several instructions (listed below) were added to the serial version to compensate for the lack of dedicated hardware lines. The serial version does not transmit until it has a complete response message (a string terminated by a line feed) to send to the host. The interface output buffer is 250 bytes in size. The "message available" bit in the status byte is always sent as 0 (zero) when using the serial interface.

The host interface is functional in both "Manual" and "Program" operation modes.

The temperature setpoint, window, ramp rate, soak time, and cycle count values associated with a particular setpoint number in "Manual" mode are distinct from the values for the like-numbered setpoint in the "Program" mode. The SETP, WNDW, RAMP, SOAK, CYCC commands and their corresponding queries act on the setup for the operation mode currently in use ("Manual" or "Program").

4-8.1 Mandatory IEEE 488.2 Common Commands and Queries

*CLS Clear the status (*ESR, TESR) registers

*ESE Set the standard event status enable (mask) register
*ESE nnn -- where nnn is 0 - 255

*ESE? Read the standard event status enable (mask) register

*ESR? Read the standard event status register
bit 7 -- power on -- NOT USED
6 -- user request -- NOT USED
5 -- command error (cme)
4 -- execution error (exe)
3 -- device dependent error (dde)
2 -- query error (qye)
1 -- request control -- NOT USED
0 -- operation complete -- NOT IMPLEMENTED

NOTE: The above bits are latched and are automatically cleared when the register is read.

*GL Go to local

*IDN? Read the product identification information (Manufacturer, model, software version). Returns TEMPTRONIC, TP04100A, PG129500A. The software version field in the return string will vary with the particular software version.

*LL Local Lockout

*RST Reset the device-specific functions ("Program" mode). The TP04100A system is forced to the Manual Operation Screen, with setpoint number 1 active. Any device-specific errors are reset. If the system was in program mode, the software configuration file, and the currently chosen test setup (including setpoints) are loaded from memory. If the system was already in manual mode, the current configuration, setup and setpoint information are left unchanged.

*SRE Set the service request enable (mask) register
*SRE nnn -- where nnn is 0 - 255.

*SRE? Read the service request enable (mask) register

*STB? Read the status byte
bit 7 -- ready
6 -- master status summary bit
5 -- standard event (esr) summary bit
4 -- message available (IEEE only, serial always 0)
3 -- temperature event (tesr) summary bit
2 -- device - specific error (eror) summary bit
1 -- not used (always 0)
0 -- "

*TST? Self test (dummy, always returns 0)

NOT IMPLEMENTED -- *OPC, *OPC?, *WAI

See IEEE Standard 488.2-1987 for more information about the commands listed above.

4-8.2 Device Specific Commands and Queries

ADMD Set the air-to-DUT maximum difference
ADMD nnn -- where nnn is 10 to 225 degrees C in 1 degree increments. Default value: 225

ADMD? Read the air-to-DUT maximum difference

AUXC? Read the auxiliary conditions register
bit 0 -- na
1 -- na
2 -- dut mode
3 -- flow on
4 -- na
5 -- na
6 -- manual mode=0, program mode=1
7 – na

CFIL Copy setup(0) to setup(n) – where n is the #(1-9)

CLER Clear the device-specific (reported by EROR?) errors

CYCC Set the ramp/soak cycle count for the current mode. Default value: 25
CYCC nnnn -- where nnnn is the # (1 - 9999) of cycles to do

CYCC? Read the number of ramp/soak cycles to do

CYCL Start/stop ramp/soak cycling
CYCL 1 -- starts
CYCL 0 -- stops

NOTE: When all cycles have been completed or when cycling was stopped on failure, it is necessary to send a CYCL 0 command to reset the system.

CYCL? Read the Ramp/soak cycle number
(current value if cycling, last value if not)

DSNS Set the DUT sensor type. Default value: 0
DSNS n -- where n is 0-2
0 -- no DUT sensor connected
1 -- type K thermocouple
2 -- type T thermocouple

DSNS? Read the DUT sensor type

DTNN Turn DUT Tuning on or off
DTNN 0 -- off
DTNN 1 -- on

DTNN? Read the tuning status

DUTC Set the device thermal constant. Default value: 100
DUTC nnn -- where nnn is nominally 100 but can range from 20-500. A higher number corresponds to a higher mass device.

DUTC? Read the device thermal constant

DUTM Turn DUT mode on or off
DUTM 0 -- off (air control)
DUTM 1 -- on (actual DUT control)

DUTM? Read the DUT mode

EROR? Read the device-specific error register (16 bits)
bit 0 -- overheat
1 -- air open loop
2 -- air sensor open
3 -- low flow
4 -- na
5 -- na
6 -- na
7 -- system error
8 -- na
9 -- No line sense (line power sense error)
10 -- na
11 -- nvram error (non volatile ram error)
12 -- bram failure (battery ram failure)
13 -- na
14 -- dut sensor open
15 -- na

FLOW Turn the flow on or off
FLOW 1 -- on
FLOW 0 -- off

LLIM — Set the lower air temperature limit. Default value: -25 °C
LLIM nnn -- where nnn is -99 to 25 degrees C.

LLIM? — Read the lower air temperature limit

NEXT — Step to the next setpoint during temperature cycling

NOTE: Stepping will occur whether or not the device is at temperature. NEXT will cause an error if the system is not in cycling mode.

RMPH — Set the heating ramp rate for the mode currently in use. Default value: Send 0 to set "MAX."
RAMH is a 3 character entry - - where the rate is 1 to 999 in whole increment steps.

RMPH? — Read the heating ramp rate

RMPC — Set the cooling ramp rate for the mode currently in use. Default value: Send 0 to set "MAX."
RAMH is a 3 character entry - - where the rate is 1 to 999 in whole increment steps.

RMPC? — Read the cooling ramp rate

RSTP — Reset device-specific functions (program mode). The ThermoStream is forced to the Program Operation Screen. Any device-specific errors are reset

SETD? — Read the dynamic temperature setpoint (changes during a ramp)

SETN — Select a setpoint to be the current setpoint
SETN n -- where n is 0 to 9 if in "Program" mode, 0 - 2 if in "Manual" mode. In "Manual" mode, setpoint #0 is HOT, #1 is AMBIENT, #2 is COLD.

SETN? — Read the current setpoint #

SETP — Set the current setpoint's temperature. Default values: Factory Settings
SETP nnn.n - - where nnn.n is the temperature (negative sign required for negative temperatures)

SETP? — Read the current temperature setpoint

SFIL — Load a setup file
SFIL n - where n is a #(1-9)

SOAK — Set the soak time for the setpoint currently in use. Default values: 120 (Program); 10 (Manual)
SOAK nnnn -- where nnnn is 0 - 9999 seconds

SOAK? — Read the soak time

STAD Set or clear ADD for the current setpoint

STAD? Read the ADD state for the current setpoint.

TECR? Read the temperature condition register (at temp/not at temp)
If bits 0 and 1 are both 0, can not indicate at temperature, or not at temperature.
Bit
0-- at temperature
1 -- not at temperature
2 -- end of test time in ramp/cycle mode
3 -- end of one cycle
4 -- end of all cycles
5 -- stopped on first fail
6 -- na
7 -- na

TEMP? Read the main temperature
Returns air temperature when in air control mode, DUT temperature in DUT mode.
NOTE: A returned value greater than 400 degrees C indicates an invalid temperature reading.

TESE Set the temperature event status enable (mask) register
TESE nnn -- where nnn is 0-255

TESE? Read the temperature event status enable (mask) register

TESR? Read the temperature event status register
bit 0 -- at temp
1 -- not at temp
2 -- end of test when in ramp/cycle mode
3 -- end of one cycle
4 -- end of all cycles
5 -- stopped on first fail
6 -- na
7 -- na
NOTE: The above bits are latched, and are automatically cleared when the register is read.

TMPA? Read the air temperature
Always returns the air temperature, whether in the air control mode, or DUT mode.
NOTE: A returned value greater than 400 degrees C indicates an invalid temperature reading.

TMPD? Read the actual DUT temperature
Always returns the actual DUT temperature, whether in the air control mode, or DUT mode.
NOTE: A returned value greater than 400 degrees C indicates an invalid temperature reading.

5-2 Figures

5-3 Tables

5-4 Introduction

The TP04100A ThermoStream System has been designed and manufactured to withstand the rigors of constant use in most manufacturing environments. To ensure many hours of trouble free service from your system, a minimum of routine maintenance consistent with that for similar equipment should be performed on a regular basis.

This section contains only those procedures considered appropriate for routine maintenance.

Refer to the Warranty, a copy is supplied near the end of this manual, concerning system service support and direct any questions to:

Temptronic Service Department

Phone: 1-800-558-5080

Telex: 211-938; answer back SERVSUR

Fax: 1-617-969-2475

E-mail: service@temptronic.com

Reader Notes

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Use this space for system user/operator sketches

5-6 Maintenance Log

The following log (Table 5-1) is provided as a suggested long term preventive maintenance schedule. Space has been provided for additional items found useful from actual system performance and experience for each installation.

For short term preventive maintenance, check the filter bowls of the filter/regulator module for water accumulation either daily or weekly (see Figure 5-1).

Table 5-1 Maintenance Log

Maintenance Item	Run Time (thousands of hours)							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Filter/Regulator module filters	[]	#	[]	#	[]	#	[]	#

[] Check and perform maintenance as required.

 # Check and replace as indicated.

5-7 Air Filter Element Servicing

When servicing air path components, including the air filter elements on the Filter/Regulator module:

WARNING 4: Make sure to turn off the ~(ac) line power and the compressed air to the TP04100A System before attempting to access or service the air filters. Do not perform this service unless qualified to do so.

AVERTISSEMENT 4: Se reporter au numéro d'Avertissement ou au numéro d'Attention approprié, dans la section « Consignes de sécurité » au début de ce manuel.

WARNUNG 4: Bitte beziehen Sie sich auf die entsprechende Warnungs- oder Vorsichtsnummer im Abschnitt über Vorsichtsmaßregeln am Anfang dieses Handbuchs.

ADVERTENCIA 4: Vea el número de la Advertencia o Precaución en la sección de "Precauciones de Seguridad", al comienzo de este manual.

Inspect the particulate air filter element and the coalescing air filter element (in that order) in the Filter/ Regulator Module (see Figure 5-1) to see if the filter elements are visibly dirty, are wet, and need to be replaced. Change the element(s) if there is loss of air flow.

The filter elements should be replaced at least once every 6 months and inspected at least once a month, preferably inspected weekly.

The coalescing air filter element may require more frequent replacement if the user's air supply is dirty and/or oily. Also, change the coalescing filter element when the differential pressure gauge indicator changes from green to red while air is flowing (indicates air pressure out is decreasing).

To check and replace air filter elements:

1. Turn off the ~ (ac) power to the TP04100A System (cease operations and power down)
2. Turn off the system's air pressure supply, then bleed all air from system by turning on ~ (ac) power to the TP04100A just long enough to exhaust all air from system, then disconnect the supply line from the air supply port (SP1) fitting on the rear panel of the controller.
3. Turn off ~ ac power at the front panel of the Controller and disconnect the power cord.
4. Push in the tab at the top of the perforated guard on the air filter, turn counterclockwise to loosen, pull down and away from its cap mount, and remove the guard.
5. Twist and pull down the glass bowl over the filter element and remove from the cap mount.
6. Inspect the filter element for dust particles, oil contamination, and any broken structure.
7. When the filter element needs to be replaced, twist and pull the filter element from its cap mount.
8. Reassemble the air filter in the reverse order of disassembly (make sure seals are in place)
9. Reconnect the power cord and turn on the ~ (ac) power at the front panel.

10. Reinstall the air pressure line at the rear of the frame module, and turn on the air source.

11. Turn on the ~ (ac) power to the TP04100A System.

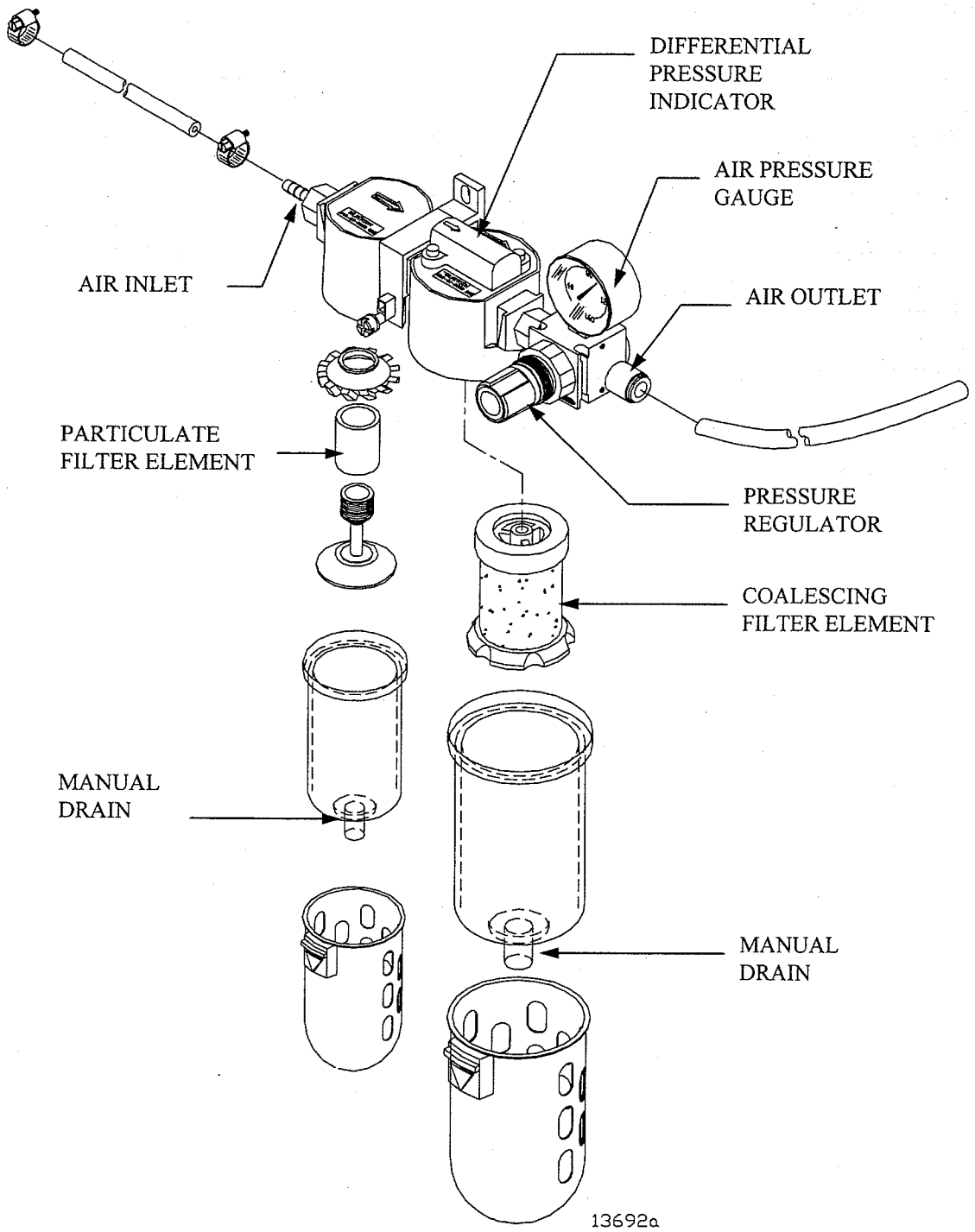

Figure 5-1 Air Filter Element Replacement

Reader Notes

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5-8 Thermocouple Input Access

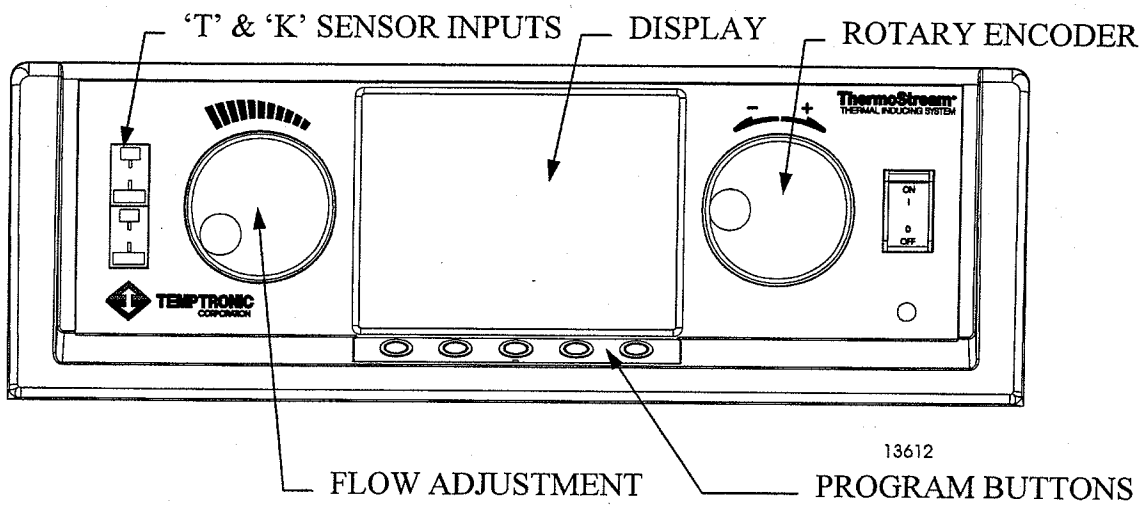

Figure 5-2 Thermocouple Input Access: DUT K, DUT T (Front Panel)

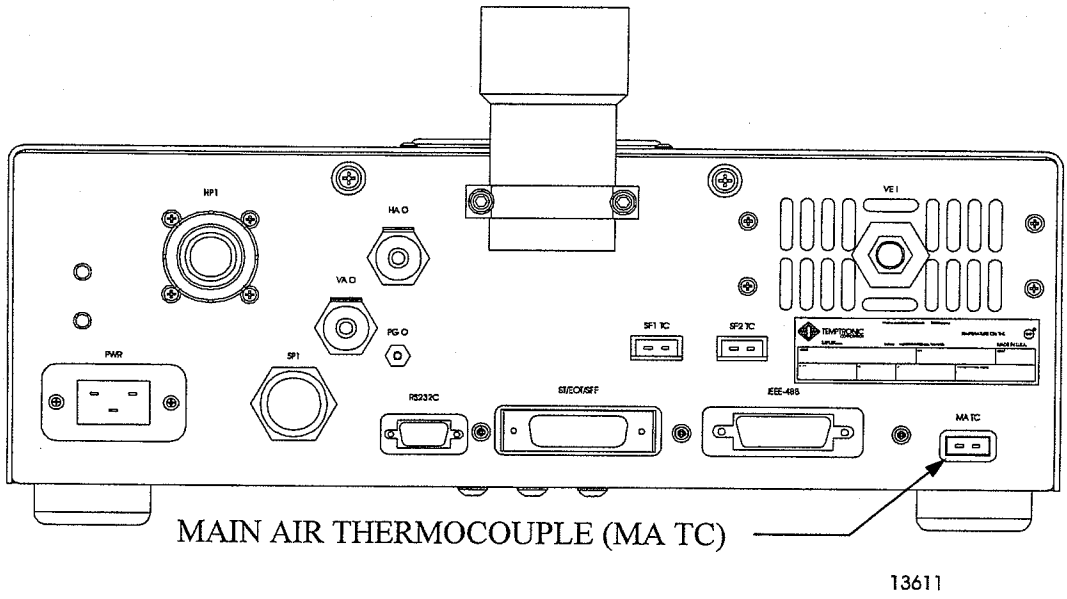

Figure 5-3 Thermocouple Input Access: Main Air (Rear Panel)

Access the thermocouple receptacles as follows:

a) Main Air thermocouple receptacle is on the Controller rear panel, labeled MA TC (see Figure 5-3).

b) DUT K thermocouple receptacle is on the Controller front panel, to the left of the display screen and to the left of the flow valve (see Figure 5-2)

c) DUT T thermocouple receptacle is on the Controller front panel, to the left of the display screen to the left of the flow adjustment valve (see Figure 5-2)

Note: the two rear panel thermocouples, labeled SF1 TC and SF2 TC, are for system use only, and have no calibration functions (see Section 2, "Overheat Safety: Sensors SF1 and SF2").

5-9 Verification: Air, DUT: T, K, Sensors

5-9.1 Verification Overview

Verification determines whether or not the TP04100A System is currently calibrated to standard or if the System needs to be recalibrated.

Before the TP04100A System is calibrated, or at any time the system calibration is questioned, perform the verification procedure as outlined below.

If periodic verifications show that the calibration performance has stabilized and is well within specifications, then the follow-up calibration procedure is not required.

Readings of the verification performance must be recorded in Table 5-2 to evaluate the deviations for determining how often calibrations are needed.

To ensure an accurate System sensor verification, follow proper temperature sensing techniques. Contact the Temptronic Service Office if you have any questions.

The verification procedure must be performed by a qualified technician. Verify that the instrumentation (external precision temperature Monitor and thermocouple sensor) used to sense the working surface temperature is in calibration. This instrumentation must be calibrated against a primary or transfer standard.

Verification is performed at two temperatures extremes: Low and High. It can also be done at other temperatures (typical test setpoints) if desired.

It is **not recommended** to use verification techniques which require inserting the Monitor thermocouple sensor into the Main Air "close to, but not touching" the System's factory installed Main Air thermocouple: precisely positioning the Monitor thermocouple is uncertain, and even small variants in Monitor thermocouple citing can skew (cause inaccurate) measurement results and prevent repeatable measurements during current and future verification sessions.

The following Approved Verification procedures use the Monitor connected in series, as a precise, repeatable, input to the System, and applies to verifying sensor accuracy in Air mode, and DUT T and DUT K modes .

5-9.1.1 Low Temperature Verification

5-9.1.1.1 Verify Main Air Mode (Low Temperature)

1. From the *Top Menu Screen*, select the "Manual" Program Button to access the *Manual Operation Screen.* Select the "Setup" Program Button to access the *Manual Test Setup Screen.* Select the "Define" Program Button to access the *Define Parameters Screen.*

2. Use the *Define Parameters Screen* to program the system for air temperature sensing as given below (see Section 3, "Setting Up Tests: Air Mode Test Setup" for details):

Define Parameters (Verify Main Air)	SET TO
DUT Control	OFF
DUT Sensor	OFF
Air temperature max (°C)	200 (or higher)
Air temperature min (°C)	-20 (or below)

3. Run System for half an hour to allow all components to stabilize at normal operating temperatures before starting verification.

4. To verify Main Air use a) an external precision temperature monitor, and b) a T type thermocouple in a "Y" configuration with one male and one female connector, configured as in Figure 5-4

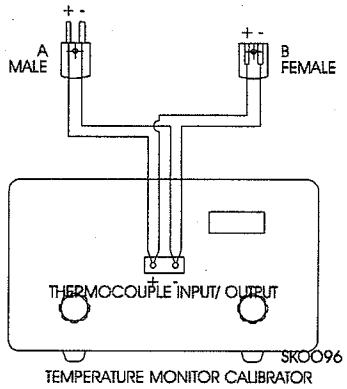

Figure 5-4 Monitor, Thermocouple, "Y" Configuration

A	To Main Air Thermocouple input "MA TC" on Controller rear panel
B	Receptacle for "MA TC" jack unplugged from Controller rear panel

5. To access the Main Air thermocouple plug, go to the rear panel of the Controller (see Figure 5-3), and carefully disconnect the Main Air thermocouple (labeled "MA TC"). To avoid bending the two pins of the thermocouple connector, gently pull the male receptacle straight out of the mating plug. Disconnecting this receptacle generates an Overheat Error on the display screen.

6. Insert the Main Air thermocouple plug which you just disconnected into the female connector of the Monitor "Y", thus connecting the Monitor to the System in series (use connector "B" on Figure 5-4). Be aware of the plug's pin polarity (do not force the wide pin into the narrow slot).

7. Connect the male Monitor "Y" plug into the Main Air thermocouple receptacle on the rear panel, again taking care to match pin polarity (use connector "A" on Figure 5-4).

8. On the user interface, press the "Esc" Program Button, which clears the Overheat Error.

9. Access the *Define Parameters Screen* (see Item 1, above) and confirm these settings: DUT control = "Off," and DUT sensor = "Off."

10. Then set the System temperature setpoint to -10.0 °C and allow the System to run until a stable AT TEMPERATURE is indicated within ±1 °C of setpoint.

11. Read the Monitor (not the System AT TEMPERATURE) and record the Monitor value in Table 5-2.

12. If the difference between the Monitor and System readings is greater than ±1 °C, then **recalibrate the System** as given in Section 0, "Calibration," after restoring the System as follows in Item 13. Note: Main Air High Temperature verification is **not required** as the Calibration procedure will automatically recalibrate both Low and High Temperatures. If the difference between Monitor and system readings is less than ±1 °C, skip to Item 14 below.

13. To restore the System, turn off main air flow; next disconnect the Monitor "Y" connectors; doing this generates an "Overheat Error" on the display screen; reconnect the Main Air thermocouple plug into the Main Air thermocouple receptacle (labeled MA TC) on the rear panel and clear the "Overheat Error" from the screen.

14. If the difference between the Monitor and System readings is between (within the range of) ±1 °C, then proceed directly to Section 5-9.1.2.1, "Verify Main Air Mode (High Temperature)" on page 5-17, and begin at Item 10, "Set System temperature to +200.0 °C..." or continue Low Temperature verification with the DUT Modes (T or K) below, and then proceed to High Temperature Verification.

5-9.1.1.2 Verify DUT T or DUT K Modes (Low Temperature)

15. Access the *Define Parameters Screen* (see Item 1, above) and program the System settings as follows:

Define Parameters (Verify DUT T or DUT K)	SET TO
DUT Control	**OFF**
DUT Sensor	T or K
Air temperature max (°C)	200 (or higher)
Air temperature min (°C)	-20 (or below)

16. Be certain to set **DUT CONTROL: "0FF" TO PREVENT HEATER DAMAGE ("Overheat Error").** We are NOT doing a DUT Mode test setup here, we are doing a DUT sensor verification setup, which will be driven by the Monitor output interfaced in series, as is given below.

17. Use the external precision temperature Monitor as the **input** to the System, rather than allowing the DUT to control the System, as follows:

18. Set the Monitor output to -10.0 °C.

19. Insert the Monitor male plug into the appropriate sensor port on the System's front panel (see Figure 5-2): if verifying the DUT T sensor, then choose the "DUT T" port; if verifying the DUT K sensor, then choose the "DUT K" port. Be aware of plug pin polarity (do not force the wide pin into the narrow opening).

20. The prior step will clear the DUT Open Loop Error on the display screen.

21. Allow the System temperature to stabilize and then record the DUT Window value in Table 5-2.

22. Compare the Monitor temperature setpoint value to the DUT Window temperature on the System display screen. **If the difference between the Monitor value and DUT Window value is greater than -10.0 ±1 °C, then recalibrate the System** as given in Section 0, "Calibration."

23. You may repeat the procedure for the other sensor type, or proceed to High Temperature Verification.

5-9.1.2 High Temperature Verification

5-9.1.2.1 Verify Main Air Mode (High Temperature)

1. From the *Top Menu Screen*, select the "Manual" Program Button to access the *Manual Operation Screen.* Select the "Setup" Program Button to access the *Manual Test Setup Screen.* Select the "Define" Program Button to access the *Define Parameters Screen.*

2. Use the *Define Parameters Screen* to program the system for air temperature sensing as given below (see Section 3, "Setting Up Tests: Air Mode Test Setup" for details):

Define Parameters (Verify Main Air)	SET TO
DUT Control	OFF
DUT Sensor	OFF
Air temperature max (°C)	200 (or higher)
Air temperature min (°C)	-20 (or below)

3. Run System for half an hour to allow all components to stabilize at normal operating temperatures before starting verification.

4. To verify Main Air, use a) an external precision temperature Monitor, and b) a T type thermocouple in a "Y" configuration with one male and one female connector, configured as shown in Figure 5-4.

5. To access the Main Air thermocouple plug, go to the rear panel of the Controller (see Figure 5-3), and carefully disconnect the Main Air thermocouple (labeled MA TC). To avoid bending the two pins of the thermocouple connector, gently pull the male receptacle straight out of the mating plug. Disconnecting this receptacle generates an Overheat Error on the display screen.

6. Insert the Main Air thermocouple plug which you just disconnected into the female connector of the Monitor "Y," thus connecting the Monitor to the System in series (use connector "B" on Figure 5-4). Be aware of the plug's pin polarity (do not force the wide pin into the narrow slot).

7. Connect the male Monitor "Y" plug into the Main Air thermocouple receptacle on the rear panel, again taking care to match pin polarity (use connector "A" on Figure 5-4).

8. On the user interface, press the "Esc" Program Button, which clears the Overheat Error.

9. Access the *Define Parameters Screen* (see Item 1, above) and confirm these settings: DUT control = "Off," and DUT sensor = "Off."

10. Then set the System temperature setpoint to +200.0 °C and allow the System to run until a stable AT TEMPERATURE is indicated within ±1 °C of setpoint.

11. Read the Monitor (not the System AT TEMPERATURE) and record the Monitor value in Table 5-2.

12. If the difference between the Monitor and System readings is greater than ±1 °C, then **recalibrate the System** as given in Section 0, "Calibration," after restoring the System as follows in Item 13. If the difference between Monitor and system readings is less than ±1 °C, skip to Item 14 below.

13. To restore the System, turn off main air flow; next disconnect the Monitor "Y" connectors; doing this generates an "Overheat Error" on the display screen; reconnect the Main Air thermocouple plug into the Main Air thermocouple receptacle (labeled MA TC) on the rear panel and clear the "Overheat Error" from the screen.

14. If the difference between the Monitor and System readings is between (within the range of) ±1 °C, then continue High Temperature verification with the DUT Modes (T or K) below, and/or proceed to program test and setpoint parameters as desired.

5-9.1.2.2 Verify DUT T or DUT K Modes (High Temperature)

15. Access the *Define Parameters Screen* (see Item 1, above) and program the System settings as follows:

Define Parameters (Verify DUT T or DUT K)	SET TO
DUT Control	**OFF**
DUT Sensor	T or K
Air temperature max (°C)	200 (or higher)
Air temperature min (°C)	-20 (or below)

16. Be certain to set **DUT CONTROL: "0FF" TO PREVENT HEATER DAMAGE ("Overheat Error").** We are NOT doing a DUT Mode test setup here, we are doing a DUT sensor verification setup, which will be driven by the Monitor output interfaced in series, as is given below.

17. Use the external precision temperature Monitor as the **input** to the System, rather than allowing the DUT to control the System, as follows:

18. Set the Monitor output to +200.0 °C.

19. Insert the Monitor male plug into the appropriate sensor port on the System's front panel (see Figure 5-2: if verifying the DUT T sensor, then choose the "DUT T" port; if verifying the DUT K sensor, then choose the "DUT K" port. Be aware of plug pin polarity (do not force the wide pin into the narrow opening).

20. The prior step will clear the DUT Open Loop Error on the display screen.

21. Allow the System temperature to stabilize and then record the DUT Window value in Table 5-2.

22. Compare the Monitor temperature setpoint value to the DUT Window temperature on the System display screen. **If the difference between the Monitor value and DUT Window value is greater than +200.0 ±1 °C, then recalibrate the System** as given in Section 5-10, "Calibration."

23. You may repeat the procedure for the other sensor type, or restore the System by disconnecting the Monitor plug from the System front panel and then setting the test and setpoint parameters as desired.

Table 5-2 Verify Sensor Accuracy Log

	Factory Verification	1st Verification	2nd Verification	3rd Verification	4th Verification
Low Temperature Verification					
Air Temp Sensor	°C	°C	°C	°C	°C
DUT Temp Sensor ( )	°C	°C	°C	°C	°C
High Temperature Verification					
Air Temp Sensor	°C	°C	°C	°C	°C
DUT Temp Sensor ( )	°C	°C	°C	°C	°C
Test Setpoint °C					
Air Temp Sensor	°C	°C	°C	°C	°C
DUT Temp Sensor ( )	°C	°C	°C	°C	°C
Test Setpoint °C					
Air Temp Sensor	°C	°C	°C	°C	°C
DUT Temp Sensor ( )	°C	°C	°C	°C	°C
Test Setpoint °C					
Air Temp Sensor	°C	°C	°C	°C	°C
DUT Temp Sensor ( )	°C	°C	°C	°C	°C
Date and initials					

Reader Notes

Use this page to record any notes. Use the "Reader Comments" card at the back of this manual to submit any comments to Temptronic Corporation.

Use this space for system user/operator sketches

5-10 Calibration

5-10.1 Calibration Overview

Verification determines whether or not the TP04100A System is currently calibrated to standard or if the System needs to be recalibrated.

Before the TP04100A System is calibrated, or at any time the system calibration is questioned, perform the sensor verification procedures given in Section 5-9.

To ensure an accurate System calibration, follow proper temperature sensing techniques. Contact the Temptronic Service Office if you have any questions.

The calibration procedure must be performed by a qualified technician.

Each temperature sensor calibration requires a precision temperature Calibrator instrument to be substituted for the sensor at the thermocouple input connector.

Verify that the instrumentation (Calibrator and thermocouple sensor) used to sense the working surface temperature is in calibration. This instrumentation must be calibrated against a primary or transfer standard.

The calibration procedure is made easier by semi-automatic system operations directed by selections from a series of display screens which perform calibration at two temperatures extremes: Low and High.

The procedure for calibrating each temperature sensor (Main Air, DUT type T, or DUT type K) is very similar. Each calibration goes through a two-step procedure at –10 °C (Low Temperature) and then at +200 °C (High Temperature). Carefully follow the instructions on each display screen (in following sections).

It is **not recommended** to use calibration techniques which require inserting the Calibrator thermocouple sensor into the Main Air "close to, but not touching" the System's factory installed Main Air thermocouple: precisely positioning the Calibrator thermocouple is uncertain, and even small variants in Calibrator thermocouple citing can skew (cause inaccurate) measurement results and prevent repeatable measurements during current and future calibration sessions.

The following Approved Calibration procedures use the Temptronic factory installed "Calibration" software program accessed from the *Setup Options Screen* and yield precise, repeatable, calibration measurements to a standard.

5-10.2 Calibrate System

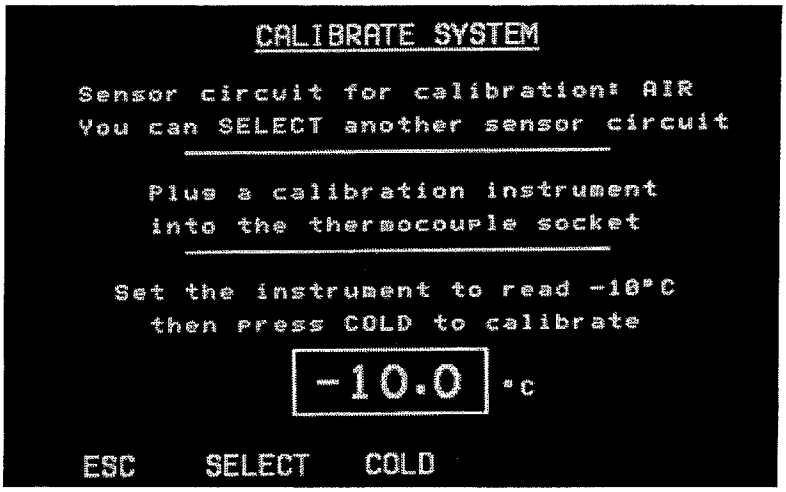

Figure 5-5 Low Temperature "Cold" Calibration Screen (-10.0 °C)

5-10.2.1 Calibrate System Screen Selections

The calibration procedure is made easier by semi-automatic system operations directed by selections from a series of display screens. When the "CAL" Program Button is selected at the *Setup Options Screen* (see Section 3), the display switches to the *Calibrate System Screen* (see Figure 5-5 above). This screen starts a menu aided procedure to calibrate temperature sensors for either the Main Air, or DUT K, or DUT T sensor mode.

The function selections at the bottom of the display screen in Figure 5-5 are summarized as follows. To run the calibration program, see the next section.

ESC: This selection returns the operator to the previous program screen or is used to exit the *Calibrate System Screen* without completing the calibration.

SELECT: This selection steps through (selects) one of the three sensors, below, to calibrate:

Air: Calibrate the Main Air thermocouple.

DUT - K: Calibrate the DUT type K thermocouple.

DUT - T: Calibrate the DUT type T thermocouple.

COLD: This selection executes the cold (low temperature) calibration step, provided the following setup is in place.

5-10.2.2 Execute the "Cold" Calibration

1. From the *Top Menu Screen*, select the "Setup" Program Button to access the *Setup Options Screen.* Select the "CAL" Program Button to access the *Calibrate System (Low Temperature "Cold" Calibration) Screen,* described in Figure 5-5.
2. Press the "Select" Program Button to step through and select either AIR, DUT K, or DUT T sensor mode to calibrate.
3. Access the desired thermocouple receptacle (see Section 5-8), on either the front or rear panel of the system.
4. If calibrating the Main Air, then unplug the male plug from the Main Air thermocouple receptacle on the rear panel (labeled "MA TC"), and insert a male plug from the (external precision monitor) Calibrator into the receptacle. If calibrating either the DUT K or DUT T, plug the Calibrator male plug into the appropriate front panel thermocouple receptacle.
5. Set the Calibrator output to -10.0 °C.
6. After the Calibrator has been set to the specified temperature, press the "COLD" Program Button.
7. During the **PLEASE WAIT...** flag on the screen, the system will automatically take a reading, store it, and then advance to the next step of the calibration procedure, below.

5-10.2.3 Execute the "Hot" Calibration

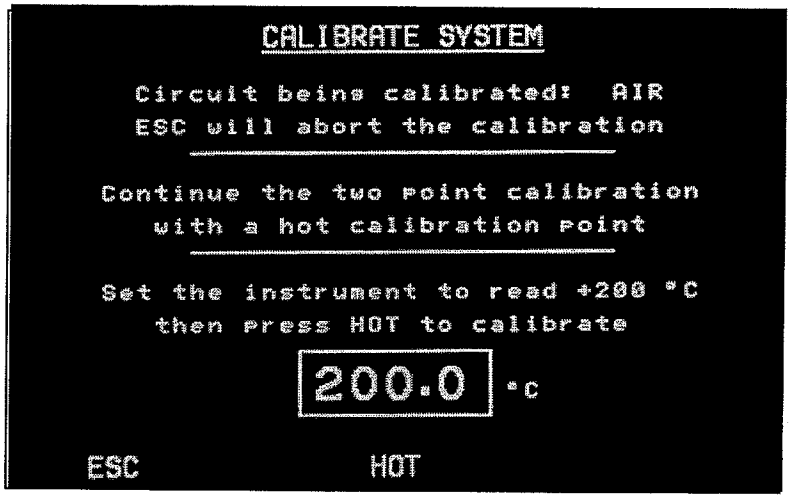

Figure 5-6 High Temperature "Hot" Calibration Screen (+200 °C)

8. When prompted, set the Calibrator output to +200.0 °C, after setting, then press the "Hot" Program Button (see Figure 5-6).

9. When the High Temperature "Hot" Calibration is completed, the system advances to the *Calibration Complete Screen,* below.

5-10.2.4 Calibration Complete Screen

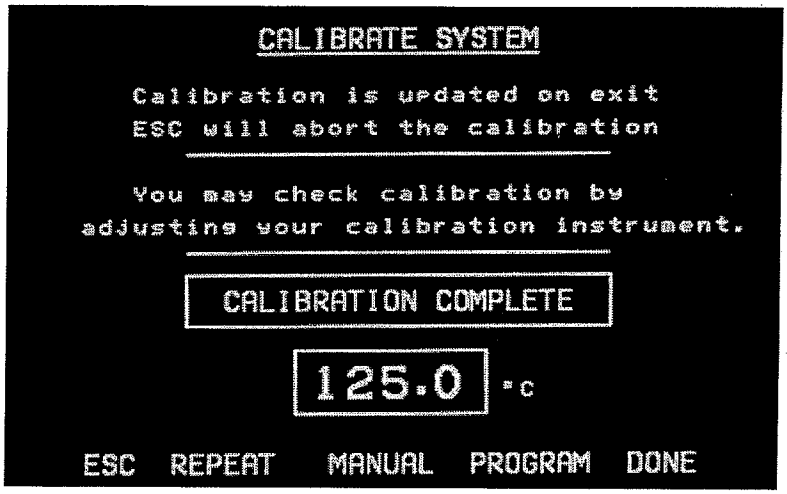

Figure 5-7 Calibration Complete Screen

Use the *Calibration Complete Screen* (see Figure 5-7) to check the accuracy of the completed calibration. Before selecting the "Done" Program Button, KEEP THE CALIBRATOR ATTACHED and a) adjust the Calibrator to any temperature within the TP04100A's temperature range, b) verify that the TP04100A display screen matches the Calibrator setpoint within ±1 °C (allow time for the system temperature to "settle"). If the calibration is valid, then select the "Done" Program Button to store the "new" calibration values.

The function selections at the bottom of the display screen in Figure 5-7 are summarized as follows:

ESC: This selection is used to exit (abort) the calibration program without accepting the completed calibration routine

REPEAT: This selection is used to either repeat the calibration of the current selected sensor (Air, or DUT K, or DUT T), or to select a different sensor mode to calibrate. Doing this returns the operator to the first calibration step (accesses the *Calibrate System Screen*) and stores (saves) the "new" calibration values.

MANUAL: This selection accesses the *Manual Operation Screen* (see Section 3). Remove the Calibrator plug from the receptacle, and, for Main Air mode, reinstall the system Main Air thermocouple plug back into the Main Air receptacle on the rear panel.

PROGRAM: This selection accesses the *Program Operation Screen* (see Section 3). Remove the Calibrator plug from the receptacle, and, for Main Air mode, reinstall the system Main Air thermocouple plug back into the Main Air receptacle on the rear panel.

DONE: This selection accepts the completed two step calibration routine, stores (saves) the "new" calibration values, and returns the operator to the *Setup Options Screen*. Remove the Calibrator plug from the receptacle (or first perform a "Post-Calibration Temperature Check," before removing the Calibrator plug), and, for Main Air mode, reinstall the system Main Air thermocouple plug back into the Main Air receptacle.

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