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**TM 504  
POWER MODULE**

Francais      Deutsch      日本語

**INSTRUCTION MANUAL**


Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97077

Serial Number 700-314

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## INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

# SERVICE SAFETY SUMMARY

## FOR QUALIFIED SERVICE PERSONNEL ONLY

*Refer also to the preceding Operators Safety Summary.*

### **Do Not Service Alone**

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

### **Use Care When Servicing With Power On**

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

### **Power Source**

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.



# CONSIGNES DE SECURITE

Ce rappel des consignes générales de sécurité s'adresse à la fois aux utilisateurs et au personnel de maintenance. Avertissements et précautions à respecter sont annotés au long de ce manuel à chaque fois que l'utilisation du TM 504 l'exige. Il est à noter que ceux-ci peuvent ne pas figurer dans cette rubrique de rappel.

## TERMES

### Dans ce manuel

Les paragraphes intitulés ATTENTION identifient les circonstances ou opérations pouvant entraîner la détérioration de l'appareil ou de tout autre équipement.

Les paragraphes intitulés AVERTISSEMENT indiquent les circonstances dangereuses pour l'utilisateur (danger de mort ou risque de blessure).

### Repères gravés sur l'appareil

CAUTION (ATTENTION) : ce mot identifie les zones de risque non immédiatement perceptibles ou un risque éventuel de détérioration de l'appareil.

DANGER (DANGER) : ce mot indique les zones de risque immédiat pouvant entraîner blessures ou mort.

## SYMBOLES

### Dans ce manuel



Ce symbole signifie «se reporter au manuel».

### Gravés sur l'appareil



DANGER – Haute tension



Borne de masse de protection (terre)



ATTENTION – se reporter au manuel

### Source d'alimentation

L'appareil est conçu pour fonctionner à partir d'une source d'alimentation maximale de 250 V efficaces entre les conducteurs d'alimentation ou entre chaque conducteur d'alimentation et la terre. Pour utiliser l'appareil en toute sécurité, une connexion à la masse, réalisée au moyen d'un conducteur prévu dans le cordon d'alimentation, est indispensable.

### Mise à la masse de l'appareil

Une fois installé dans le châssis d'alimentation, l'appareil est relié à la masse à l'aide d'un conducteur du cordon d'alimentation. Pour éviter tout choc électrique, insérer la prise du cordon d'alimentation dans une prise de distribution correspondante, avant de connecter l'entrée ou les sorties de l'appareil. Pour utiliser l'appareil en toute sécurité, une connexion à la masse, réalisée au moyen d'un conducteur prévu dans le cordon d'alimentation, est indispensable.

### Danger provoqué par la coupure de connexion de masse

En cas de coupure de la connexion de masse, tous les éléments conducteurs accessibles (y compris boutons et commandes apparaissant isolants) peuvent provoquer un choc électrique.

### Utiliser le cordon d'alimentation approprié

N'utiliser que le cordon d'alimentation et la prise recommandés pour votre appareil.

Utiliser un cordon d'alimentation en parfait état.

Pour toute information détaillée concernant cordons et prises d'alimentation, se reporter au chapitre «Maintenance» du manuel en Anglais.

Seul, un personnel qualifié peut procéder à un changement de cordon et prises.

### Utiliser le fusible approprié

Pour éviter tout risque d'accident (incendie...) n'utiliser que le fusible recommandé pour votre appareil.

Le fusible de remplacement doit toujours correspondre au fusible remplacé : même type, même tension et même courant. Un remplacement de fusible ne doit être effectué que par un personnel qualifié.

### Ne pas utiliser l'appareil en atmosphères explosives

Pour éviter toute explosion, ne pas utiliser cet appareil dans une atmosphère de gaz explosifs.

### Ne pas démonter les capots ou les panneaux

Pour éviter toute blessure, ne pas ôter les capots ou les panneaux. N'utiliser l'appareil que si ceux-ci ont été correctement remis en place.

# SICHERHEITSANGABEN FÜR DEN ANWENDER

Die allgemeinen Sicherheitsinformationen in diesem Teil der Angaben dienen dem Anwender- und Servicepersonal. Spezielle Warnungen und Hinweise sind überall im Handbuch zu finden, müssen jedoch in diesen Angaben nicht erscheinen.

## BEGRIFFE

### In diesem Handbuch

**VORSICHTSHINWEISE** erläutern Bedingungen, die zur Zerstörung des Gerätes oder anderer Gegenstände führen können.

**WARNUNGSHINWEISE** erläutern Bedingungen, die zu Personenschäden führen können oder lebensgefährlich sind.

### Markierungen auf dem Gerät

**CAUTION – VORSICHT** weist darauf hin, daß durch zufälliges Berühren an einer nicht unmittelbar zugänglichen Stelle Personenschaden entstehen kann, oder Schaden am Gerät selbst.

**DANGER – GEFAHR** weist darauf hin, daß durch zufälliges Berühren an einer zugänglichen Stelle Personenschaden entstehen kann.

## SYMBOLE

### In diesem Handbuch



Dieses Symbol zeigt an, wo Vorsicht walten zu lassen ist, oder wo Informationen zu finden sind.

### Markierungen auf dem Gerät



GEFAHR – Hochspannung.



Schutzerdungskontakt.



ACHTUNG – beziehen Sie sich auf das Handbuch.

### Netzspannungsversorgung

Die Betriebsspannung für dieses Gerät darf 250 V<sub>eff</sub> nicht überschreiten und ist an die Versorgungsleitungen bzw. an eine Versorgungsleitung und Masse anzulegen. Innerhalb des Netzanschlußkabels muß ein Schutzleiter vorhanden sein, der mit Gerätemasse verbunden ist.

### Masseanschluß des Gerätes

Dieses Gerät wird über den Schutzleiter der Versorgungseinheit mit Erdpotential verbunden. Zur Vermeidung von elektrischen Schlägen ist vor der Beschaltung der Ein- und Ausgänge der Netzstecker in eine korrekt verdrahtete Steckdose einzustecken. Verwenden Sie den Schutzleiter nicht als einzige Verbindung zwischen zwei oder mehreren Geräten. Zur Vermeidung von elektrischen Schlägen sind die Geräte untereinander mit separaten Leitungen zu verbinden.

### Gefahr durch fehlende Schutzerde

Durch eine fehlende Schutzerde, können alle berührbaren, leitenden Teile (einschließlich Knöpfe und andere Bedienungselemente, die isoliert sind) einen elektrischen Schlag bei der Berührung auslösen.

### Verwendung eines richtigen Netzkabels

Verwenden Sie nur Netzkabel, die für die Versorgungseinheit geeignet sind und die sich in gutem Zustand befinden.

Für detaillierte Informationen über Kabel und Stecker beziehen Sie sich bitte auf Abbildungen innerhalb des Handbuches.

Ein Austausch von Kabeln und Steckern ist nur von geschultem Personal vorzunehmen.

### Verwendung einer richtigen Sicherung

Zur Vermeidung von Brandschäden sind nur Sicherungen zu verwenden, die in den Teilelisten dieses Gerätes aufgeführt sind und die in Spannungs- und Stromwert entsprechend sind.

Ersatz von Sicherungen ist nur von geschultem Personal vorzunehmen.

### Arbeiten Sie nicht in explosiver Umgebung

Zur Vermeidung von Explosionen ist die Inbetriebnahme dieses Gerätes in explosiver Umgebung zu unterlassen, wenn das Gerät nicht dafür geeignet ist.

### Entfernen Sie keine Gehäuseabdeckungen

Zur Vermeidung von Personenschäden sind keine Gehäuseteile zu entfernen. Auch ist das Gerät ohne Gehäuse nicht in Betrieb zu nehmen.

## ご使用前に

この章では操作する方およびサービス・エンジニアの方に安全にお取り扱いいただくための注意事項が述べられています。

### 用語

#### マニュアル中の用語

**注意**の項は本機器または他の接続機器に損傷を及ぼす恐れのある場合の注意です。

**警告**の項は人体に損傷を与えたり生命に危険を及ぼす恐れのある場合の注意です。

#### 機器上に記されている用語

**CAUTION**は人体および本機器または周辺機器に損傷を及ぼす恐れがある部分を示しています。

**DANGER**は人体に損傷を及ぼしたり生命に危険を与える恐れがある部分を示しています。

### 記号

#### この取扱説明書に出てくる記号



このマークは適切な注意、または他の項目を参照する必要がある場合を指示しています。

#### 機器に記された記号



危険——高電圧



保護用接地ターミナル



注意——取扱説明書参照

#### 電源

本機器は電源コードの線間、あるいは電源コードとグラウンド間が250Vrms以内の範囲の電源で作動します。安全のために電源コードのアース線で接地して下さい。

#### 機器の接地

本機器は電源コードのアース線で接地されます。電氣的ショックを避けるために、電源コードをコンセントに差し込んでから、機器の入、出力端子への接続を行って下さい。電源コードの接地線を用いて接地を行うと安全です。

#### 電源本体の接地

電氣的ショックを防止するため、電源本体は確実に接地して下さい。接地が行われていないと、導体の部品（絶縁処理されたノブおよびコントロールつまみを含む。）により電氣的ショックを受けることもあります。

#### 電源コード

電源コードとコネクタは機器に適合するものをお使い下さい。

電源コードに損傷がないことをお確かめ下さい。

電源コードとコネクタに関する詳細は本体取扱説明書をご参照下さい。

電源コードとコネクタの交換については当社エンジニアにおたずね下さい。

#### ヒューズ

危険防止のため、マニュアルに記載されている仕様に適合するヒューズをご使用下さい。

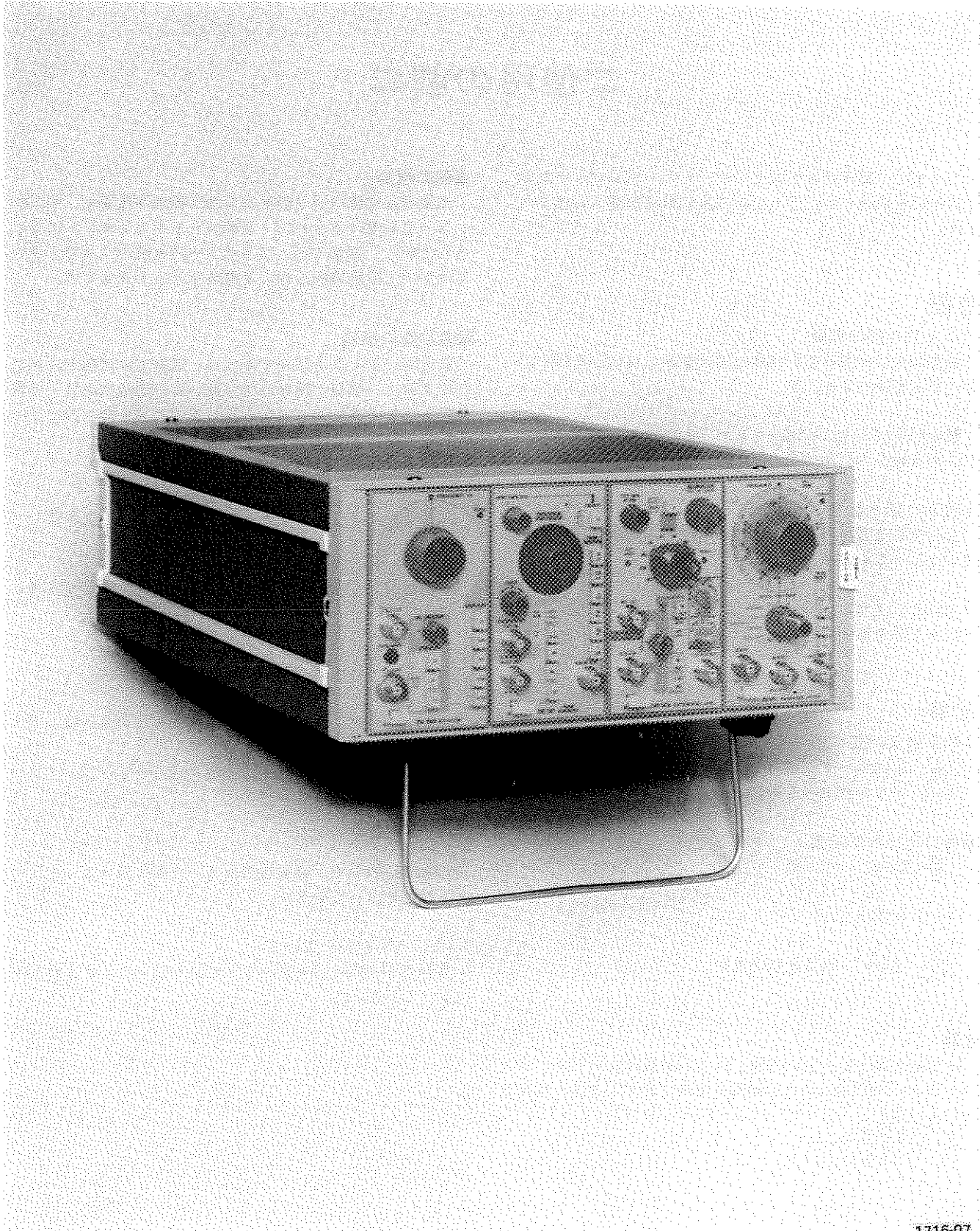
ヒューズの交換に関する詳細は、当社フィールド・エンジニアにおたずね下さい。

#### 爆発防止

危険防止のため、爆発性のガスが周囲にあるような所では作動させないで下さい。

#### カバー、パネルについて

プラグインのカバーやパネルを取りはずしたまま作動させないで下さい。



1716-07

TM 504 Power Module with plug-ins.



# SPECIFICATION

## INTRODUCTION

### Description

The TM 504 is a four-wide power module compatible with all TM 500 plug-ins. It provides unregulated dc and ac supplies and non-dedicated power transistors for plug-in usage. It features a high-power compartment for special plug-ins or applications. Option 2 rear interface allows

interconnection of special features between plug-ins or with external devices through the back panel.

### Performance Conditions

The values listed below are valid only when the instrument is operated at an ambient temperature between 0°C and 50°C.

Table 1-1  
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
<b>SUPPLIES</b>		
+33.5 Vdc		+23.7 V to +40.0 V
Tolerance <sup>a</sup>		
PARD (Periodic and Random Deviation)		≤2.5 Vpp
Maximum load		350 mA
Maximum load di/dt		10 mA/μs
−33.5 Vdc		
Tolerance <sup>a</sup>		−23.7 V to −40.0 V
PARD		≤2.5 Vpp
Maximum load		350 mA
Maximum load di/dt		10 mA/μs
+11.5 Vdc <sup>b</sup>		
Tolerance <sup>a</sup>		+7.6 V to +16.0 V
PARD		≤2.5 Vpp
Maximum load		
Standard compartment		1.3 A
High-power compartment		4.0A
Maximum load di/dt		20 mA/μs

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
25 Vac (2 each)		
Range		25.0 Vrms +10%, -15% floating
Maximum load		
Standard compartment		25 VA
High-power compartment		60 VA
Maximum floating voltage		350 V peak
17.5 Vac <sup>b</sup>		
Range		With a grounded center tap 20.5 Vrms +10%, -20%
Maximum load		
Standard compartment		30 VA
High-power compartment		95 VA
Maximum plug-in power drawn from mainframe <sup>c</sup>		
Standard compartment		35 Wdc or 75 VAac
High-power compartment		45 Wdc or 125 VAac
Combined power drawn sharing limitation <sup>c</sup>		
Standard compartment		VAac + 2.1 (Wdc) ≤ 75 VAac
High-power compartment		VAac + 2.1 (Wdc) ≤ 150 VAac
Fuse data		
+33.5 Vdc		2.5 A, 3 AG, fast blow
-33.5 Vdc		2.5 A, 3 AG, fast blow
+11.5 Vdc		7.5 A, 3 AG, fast blow
-11.5 Vdc, high power		5 A, 3 AG, slow blow
<b>SERIES PASS TRANSISTORS</b>		
Type		One each NPN or PNP per compartment.
Maximum dissipation		
Standard compartment		7.5 W each, 15 W total
High-power compartment		30 W each, 50 W total

Table 1-1 (cont.)

Characteristics	Performance Requirements	Supplemental Information
<b>SOURCE POWER REQUIREMENTS</b>		
Voltage ranges		Selectable 100 V, 110 V, 120 V, 200 V, 220 V, and 240 V nominal line $\pm 10\%$
Line frequency		48 Hz to 60 Hz
Max power consumption		Approximately 320 W
Fuse data		
100 V, 110 V, 120 V ranges		4 A, 3 AG, slow blow
200 V, 220 V, 240 V ranges		2 A, 3 AG, slow blow
<b>MISCELLANEOUS</b>		
Maximum recommended plug-in power dissipation		
One-wide		10 to 15 W
Two-wide		25 to 35 W

<sup>a</sup> Worst case; low line-full load and high line-no load values including PARD:

<sup>b</sup> Floating in high-power compartment, 350 V peak.

<sup>c</sup> At nominal line voltage.

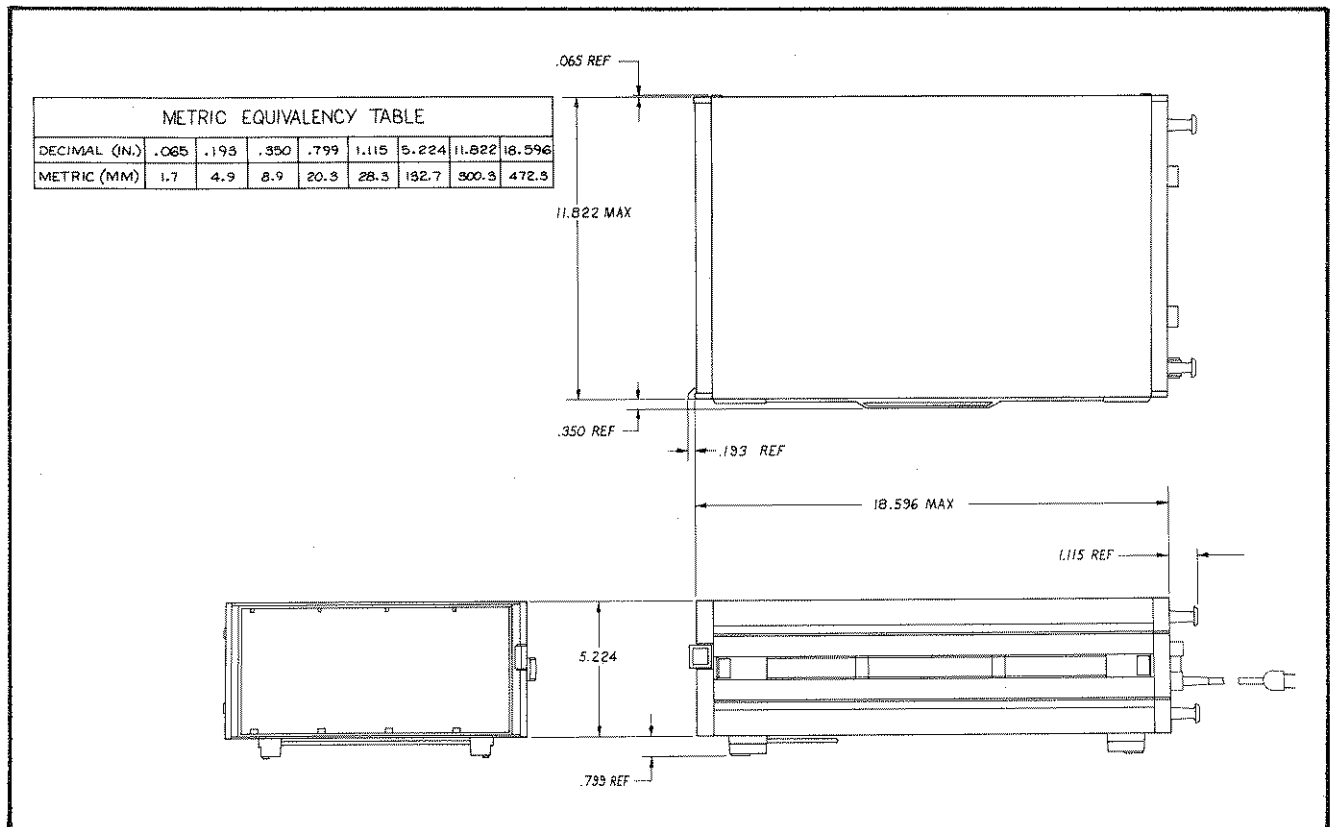


Fig. 1-1. TM 504, Outline Drawing.

Table 1-2  
**PHYSICAL CHARACTERISTICS**

Characteristics	Supplemental Information
<b>ENVIRONMENTAL</b> <sup>a, b</sup>	
Overall	Meets or exceeds MIL-T-28800B, class 5 requirements with exception for vibration, shock, and EMC.
Temperature	
Operating	0°C to +50°C
Non-operating	-55°C to +75°C
Humidity	90-95% RH for 5 days cycled to +50°C.
Altitude	
Operating	4.6 km (15,000 ft)
Non-operating	15 km (50,000 ft)
Vibration	0.38 mm (0.015"), 5 Hz to 55 Hz, 75 minutes.
Shock	20 g's (1/2 sine), 11 ms, 18 shocks
Bench handling	45°, 4", or equilibrium whichever occurs first
Transportation	Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1 and 1A-B-2.
<b>MECHANICAL</b>	
Net weight	
TM 504	18.5 lbs (8.4 kg)
Overall dimensions	
TM 504	9.5 in (24.1 cm)H, 12.0 in (30.5 cm)W, 20.0 in (50.8 cm)L

<sup>a</sup> With plug-ins. Some plug-ins require additional limitations.

<sup>b</sup> Meets MIL-T-28800 B, class 5 without plug-ins (0.015" displacement, 30 g's shock).

# OPERATING INSTRUCTIONS

## GENERAL

### Installation

For full installation instructions refer to the procedure at the end of this section.

### Power Source

The TM 504 is designed to operate from a power source with its neutral at or near earth (ground) potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multi-phase system.

### Power Usage

With four plug-ins installed, the TM 504 may require up to 220 watts at the upper limits of high line voltage ranges. Actual power consumption depends on the particular plug-in configuration and operating modes selected.

**High Power Compartment.** Some TM 500 Series plug-in modules require high power to operate at their maximum capabilities. To meet this requirement the TM 504 has a high power compartment. When viewed from the front this compartment is on the extreme right side of the unit.

**Loading Considerations.** The power capability of the TM 504 can best be used by carefully planning the plug-in configuration, the external loads, and the resulting power distributions. Optimum conditions may be obtained by:

1. Having equal loads in all compartments.
2. Dissipating as much power as possible in the external loads.
3. Operating the system in an ambient temperature near 25°C.

Each plug-in is provided access to a pair of heat-sinked, series-pass transistors, one NPN and the other PNP. These transistors enable the plug-in to operate in power ranges not possible if the power were to be dissipated in the plug-ins themselves.

### Operating Temperatures

The TM 504 can be operated in an ambient air temperature of 0°C to 50°C. Thermal cutout devices

protect the system by disconnecting the power to the TM 504 Power Module when internal temperatures rise above a safe operating level. These devices automatically return power to the unit when the internal temperatures return to a safe level.

Since the TM 504 can be stored in temperatures between -40°C and +75°C, allow the instrument's chassis to return to within the operating limits before applying power.

### Power Modules

It is not necessary that all the plug-in compartments be utilized in order to operate the Power Module. The only modules needed are those necessary to complete the task.

### CAUTION

*Turn the Power Module off before inserting the plug-in; otherwise damage may occur to the plug-in circuitry.*

### Module Installation

1. Check the location of the white plastic barrier keys on the TM 504 interconnecting jack to ensure that their locations match the slots in the edge of the plug-in module's circuit board.

2. Align the plug-in module chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack. (Remove the plug-in module by pulling on the white release latch in the lower left corner of each module.)

### Turn-on Procedure

After completing the installation procedure, found at the end of this section, and installing the plug-ins, pull the PULL ON POWER switch on the right side of the TM 504. Some plug-ins have independent power switches, usually labeled OUTPUT, controlling application of mainframe power to the plug-in. Press this button to activate the plug-in.

## BUILDING A SYSTEM

### Family Compatibility

Mechanically, the plug-in modules are very similar to other Tektronix product families. However, they are not electrically compatible. Therefore, the TM 504 interface has barriers on the mating connectors between pins 6 and 7 to ensure that incompatible modules cannot be inserted. See Fig. 2-1. A compatible module will have a matching slot between pins 6 and 7 of its main circuit board edge connector. This slot and barrier combination is the primary keying assignment.

TM 500-compatible plug-in modules are also identified by the white color of the release latch.

### Customizing the Interface

The modularity of this instrumentation system provides for many different functions to be performed by the plug-in modules. Specific functions are grouped into families or classes, of which there may be several plug-in module members. For instance, some classes are Power Supplies, Signal Sources, Measurement, and so forth. Each modular member of a functional family will have a second slot peculiar to its family assignment located in its edge

connector. The TM 504 user can "program" one or more compartments to accept only members of that family by installing a second barrier in the interface connector to match the module's slot location. An entire TM 504 can be "programmed" in this manner to set up instruction systems for specific work functions. For extra barriers, order Tektronix Part No. 214-1593-02.

Jumper wires can be used to further specialize the interface. Compartments can be made to "talk" to each other by connecting jumpers on the back side of the interface board, using pins 14 through 28 (A-side and B-side both) of the interconnecting jacks. See the following description of Option 2. Refer to each plug-in module's Manual for the I/O assignments of each pin at the rear interface. Once having made interconnections of a specialized nature, it is recommended that barriers be installed on the interconnecting jacks to ensure module compatibility with the customized wiring.

### Rear Panel

The rear subpanel has a connector mounting plate for BNC and multi-pin connector mountings. Customer or factory-installed connectors and wiring (see following description of Option 2) could provide external access to the interface for external I/O control. This feature makes

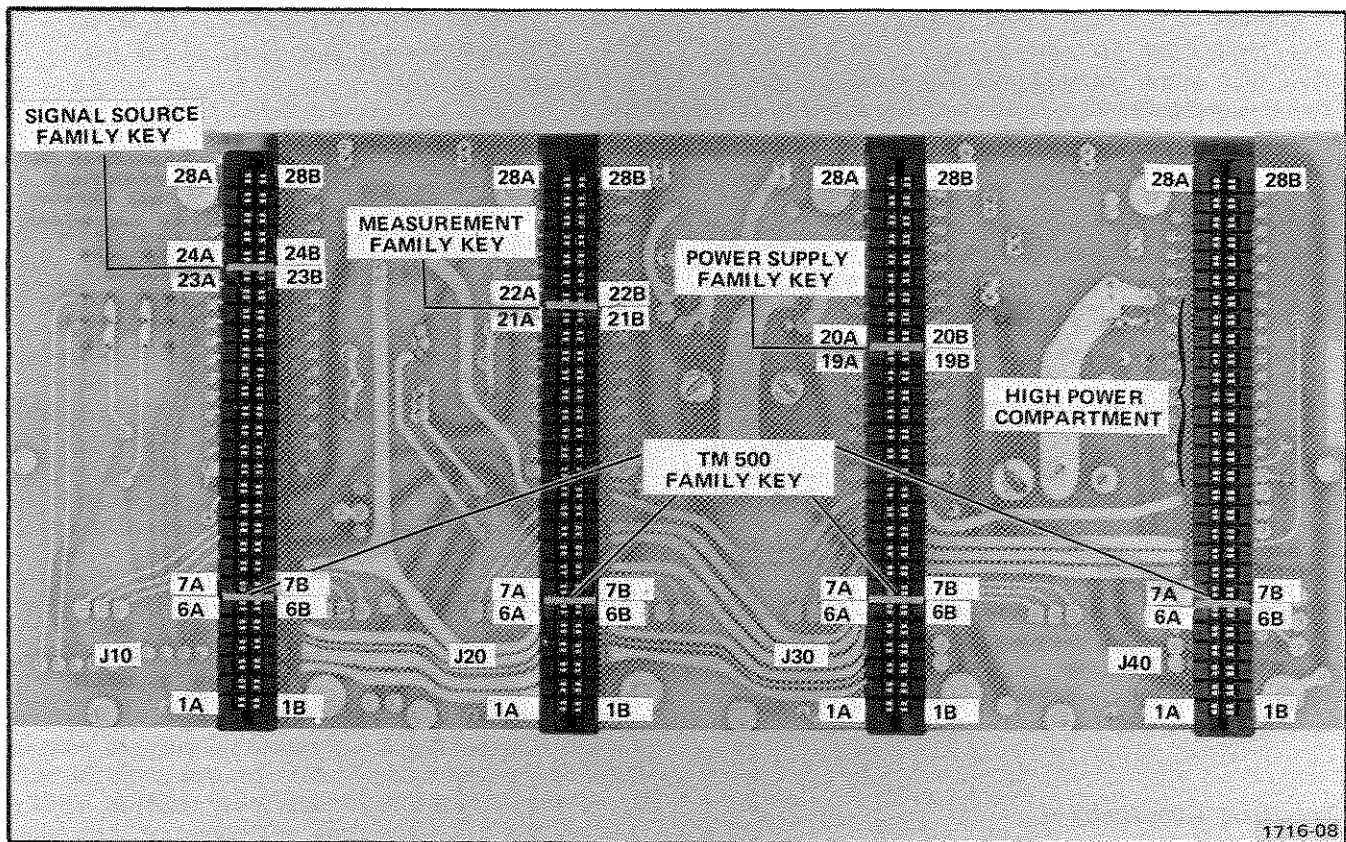


Fig. 2-1. Keying assignments for family functions. One of many possible sequence combinations.

the TM 500 Series Modular Instrumentation System very flexible in bench-top or rackmounted systems.

**Option 2.** This factory-installed option adds 25-mil square-pin connectors to the rear of the interconnecting jacks at all pin locations from pins 14A and B through pins 28A and B. This will keep the interface flexible by making it easy and fast to change customized wiring using prepared wires with square-pin receptacles and long-nose pliers or tweezers. It also protects the circuit board from damage by repeated soldering and unsoldering of jumper wires. This option also adds six BNC connectors and one 50-pin connector to the rear panel. These connectors are not pre-

wired. Instead, prepared jumpers, coaxial cables, and interconnection jack barriers are included in a kit. This gives a system designer as much flexibility as possible.

## INSTALLATION AND PRE-TURN ON PROCEDURE

Check the rear panel markings. If the factory settings are compatible with the available line voltage and frequency, insert the desired plug-ins and use the bail to raise the front of the instrument. If a change is needed, refer a qualified service person to the procedure in the Maintenance section of this manual.





# INSTRUCTIONS D'UTILISATION

## Installation

Les instructions complètes d'installation figurent à la fin de ce chapitre.

## Source d'alimentation

Le TM 504 est conçu pour fonctionner à partir d'une source d'alimentation dont le neutre se trouve au potentiel de la terre ou en est très peu différent, avec un conducteur de protection mis à la terre et séparé. Il n'a pas été prévu pour fonctionner entre deux phases d'un réseau multiphasé.

## Consommation

Avec 4 tiroirs installés dans le châssis d'alimentation, le TM 504 peut nécessiter jusqu'à 220 W de puissance dans la gamme supérieure de la tension réseau. La consommation effective est fonction des caractéristiques du tiroir et du mode d'utilisation sélectionnés.

**Compartiment haute puissance.** Certains tiroirs de la série TM 500 requièrent une puissance accrue afin de pouvoir fonctionner au maximum de leurs possibilités. Pour satisfaire à cette exigence, le TM 504 possède un compartiment haute puissance. Lorsque l'on regarde l'avant de l'appareil, ce compartiment se trouve à droite.

**Considération de charge.** Afin d'employer au mieux la capacité de puissance du TM 504, il faut déterminer avec grand soin la configuration des tiroirs, les charges externes ainsi que les consommations respectives. Une utilisation optimale consiste :

1. A répartir des charges égales dans tous les compartiments.
2. A consommer le maximum de puissance dans les charges extérieures.
3. A utiliser l'ensemble à une température ambiante d'environ 25°C.

Le TM 504 alimente chaque tiroir par l'intermédiaire d'une paire de transistors (un NPN et un PNP) montés sur châssis servant de radiateur. Ces transistors, montage série, permettent d'abaisser les tensions d'alimentation nécessaires au tiroir utilisé sans dissiper de puissance dans les tiroirs eux-mêmes.

## Température de fonctionnement

Le TM 504 peut être utilisé à une température ambiante comprise entre 0°C et 50°C. Un disjoncteur thermique protège l'ensemble en déconnectant la source d'alimentation du

TM 504 lorsque la température interne dépasse un seuil de fonctionnement de sécurité. Ce dispositif rétablit automatiquement l'alimentation de l'appareil lorsque la température interne est redevenue normale.

Puisque le TM 504 peut être stocké à une température comprise entre -40°C et +75°C, il faut laisser au châssis le temps d'atteindre la température normale d'utilisation avant de mettre l'appareil sous tension.

## Tiroirs

Il n'est pas nécessaire d'utiliser tous les compartiments pour faire fonctionner le châssis d'alimentation. Les seuls modules nécessaires sont ceux requis pour réaliser une fonction.

### ATTENTION

*Couper l'alimentation du TM 504 avant l'insertion ou l'extraction de tout tiroir, des arcs électriques risquant de détériorer les circuits.*

## Installation du module

1. Vérifier que les détrompeurs en plastique, situés sur les connecteurs du TM 504 correspondent aux encoches du circuit imprimé du tiroir utilisé.
2. Aligner les rainures supérieures et inférieures du tiroir avec les guides du compartiment sélectionné. Insérer le tiroir et le pousser à fond pour que le circuit imprimé se place correctement dans le connecteur (pour extraire le tiroir, tirer sur la tirette de verrouillage située au coin inférieur gauche du panneau avant).

## Mise en service

Après avoir terminé les opérations de mise en service (informations détaillées à la fin de ce chapitre) et installé les tiroirs, tirer le commutateur PULL ON POWER, situé sur le côté droit du TM 504. Certains tiroirs sont munis de commutateurs de mise en service indépendants, normalement dénommés OUTPUT. Ceux-ci transmettent les alimentations du châssis d'alimentation vers le tiroir sélectionné. Appuyer sur ces boutons pour mettre en service ces tiroirs.

## CONCEPTION D'UN SYSTEME

### Compatibilité

Mécaniquement, les tiroirs modulaires de la série TM 500 sont très similaires aux autres familles de produits Tektronix. Cependant, ils ne sont pas compatibles électriquement. Par

conséquent, l'interface du TM 504 est muni de détrompeurs situés sur les connecteurs correspondants, entre les broches 6 et 7. Cette conception empêche l'insertion de tout tiroir qui ne serait pas compatible. Se reporter à la figure 2-1. Un tiroir compatible doit posséder une encoche correspondant au détrompeur entre les broches 6 et 7 sur le connecteur de son circuit imprimé principal. L'association d'une encoche et de son détrompeur permet d'identification de la fonction et assure la compatibilité des tiroirs.

La tirette de sécurité de couleur blanche est un autre moyen d'identifier la compatibilité des tiroirs de la série TM 500.

### Conception de l'interface selon les besoins spécifiques du client

La modularité de ce système permet de réaliser une multitude de fonctions à l'aide des tiroirs. Des fonctions spécifiques sont regroupées par familles ou catégories, chacune de ces familles pouvant comprendre plusieurs tiroirs, par exemple, les familles d'alimentations, de générateurs de signaux, d'instruments de mesures, etc... Chaque tiroir modulaire, membre d'une famille réalisant la même fonction, possède une seconde encoche assignée à cette famille et située sur le connecteur. L'utilisateur du TM 504 peut donc « programmer » un ou plusieurs compartiments afin que ceux-ci n'acceptent que les membres d'une même famille. Pour cela, il suffit d'installer un second détrompeur sur le connecteur d'interface en face de l'encoche correspondante. Un appareil TM 504 complet peut être personnalisé de cette manière, en permettant l'élaboration du système d'instructions pour des fonctions spécifiques. Pour se procurer des détrompeurs supplémentaires, passer commande de la référence Tektronix 214-1593-02.

Des cavaliers câblés peuvent spécialiser l'interface. Des compartiments peuvent ainsi « se parler » en connectant des cavaliers du côté arrière de la carte d'interface par l'intermédiaire des broches d'interconnexion 14 à 28 (côtés A et B ensemble). Pour de plus amples informations, se reporter à la description de l'option 02. Se reporter également au manuel d'instructions concerné afin de connaître l'assignation de chaque broche I/O (entrée/sortie) placée sur l'interface arrière. Après avoir réalisé les interconnexions pour une utilisation spécialisée, il est recommandé d'installer les détrompeurs de telle sorte qu'ils garantissent la compatibilité du module avec le câblage effectué.

### Panneau arrière

Le panneau arrière est perforé afin de recevoir des prises BNC et un connecteur multi-broches. Les connecteurs et le câblage, montés en usine ou installés par l'utilisateur (se reporter à la description de l'option 02) donnent accès aux entrées/sorties externes par l'intermédiaire de l'interface. Cette caractéristique confère aux systèmes de mesures de la série modulaire TM 500 une grande souplesse d'emploi qu'il s'agisse de système en coffret ou en baie.

**Option 02.** Cette option, installée en usine, consiste à adjoindre des connecteurs à broches carrées sur l'arrière de l'interface. Ils sont montés sur les emplacements des broches 14A et B à 28A et B. Cette souplesse d'utilisation de l'interface favorise la modification rapide et aisée du câblage pour une utilisation propre aux besoins du client. On utilise alors des câbles préparés et munis de prises femelles pour broches carrées et de pinces à longs crochets. Ce système protège également le circuit imprimé des détériorations pouvant provenir des soudures et dessoudures répétées. Cette option comprend 6 connecteurs BNC et un connecteur à

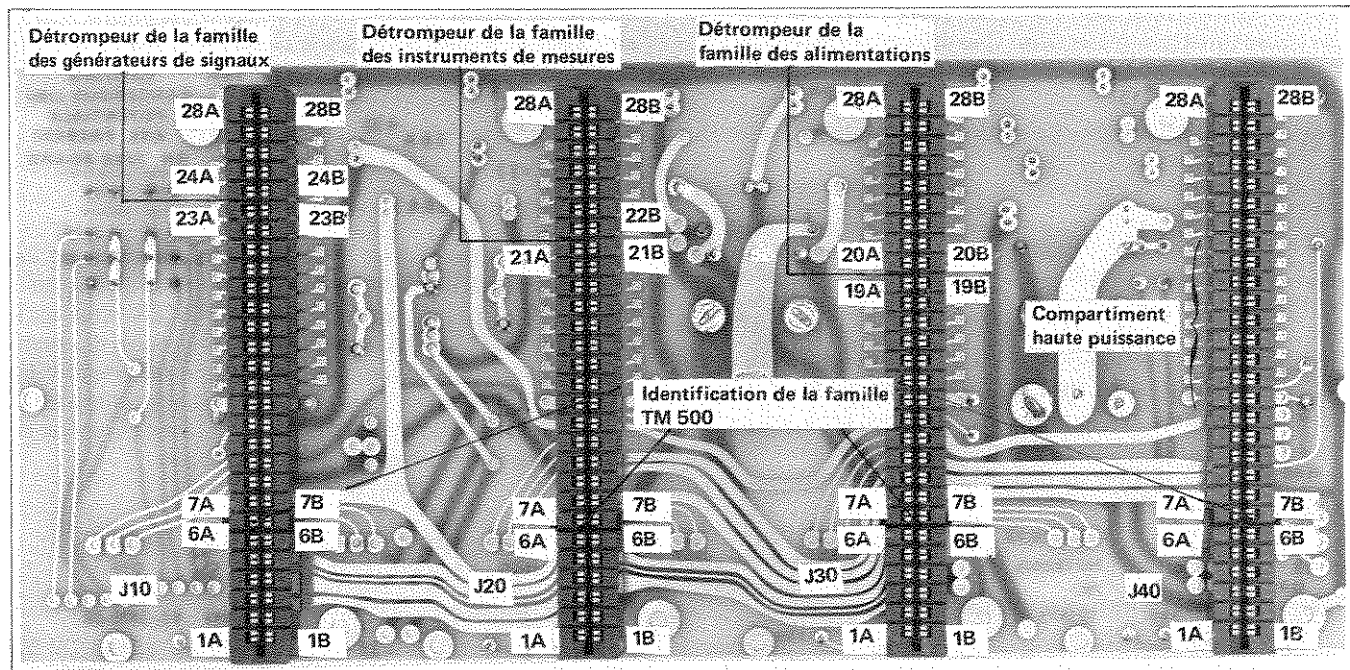


Fig. 2-1. Identifications des fonctions par familles. Un exemple des nombreuses combinaisons possibles. TF1716-10

50 broches sur le panneau arrière. Ces connecteurs ne sont pas précâblés afin que l'utilisateur puisse concevoir son système avec souplesse. Des détrompeurs font partie du kit global.

## INSTALLATION ET PROCEDURE DE MISE EN ROUTE

Vérifier les repères du panneau arrière. Si les montages effectués en usine sont compatibles avec la tension réseau et la fréquence disponibles, insérer les tiroirs et utiliser la barre d'appui pour incliner l'avant de l'appareil. Si une modification est nécessaire, faire appel à un personnel qualifié et se reporter à la méthode figurant au chapitre «Maintenance» du manuel en Anglais.



# TM504型 取扱説明

## はじめに

### 取付け

取付け手順に関しては本章の最後の部分に述べられています。

### 電源

TM504型はアース電位の中性点を持った電源で使用するよう設計されています。多相システムの2相または単相3線システムの2線で動作させることはできません。

### 高電力プラグイン・ホール

TM500シリーズのプラグインには、十分な機能を発揮するには高電力を必要とするものもあります。この要求に答えるため、TM504型には高電力プラグイン・ホールが備わっています。機器のフロントパネルに向かって一番右手のプラグイン・ホールが高電力供給用となっています。

### 消費電力

3台のプラグインが組み込まれた場合、TM504型は最高120Wの電力を必要とします。実際の消費電力はプラグインの組み合わせや動作状態によって変わります。

### 負荷について

実際の消費電力はプラグインの組合せによって異なります。

電力はプラグインの機能的な組合せ、外部負荷、各々のプラグインの消費電力に注意して効率よくご使用下さい。

最適の状態とは、

- (1) 3つのプラグイン・ホールがすべて同じ負荷で、高電力プラグイン・ホールでは負荷が最大であること。
- (2) 電力はできる限り外部負荷で消費すること。
- (3) 約25℃の周囲温度で使用する。

TM504型は、各プラグインに対してシャーシでヒートシンクされたNPN、PNP各1個ずつのシリーズ・トランジスタにより電力を供給しています。

### 動作温度

TM504型は0～50℃の周囲温度で動作することができます。内部温度が安全動作温度以上に上がった場合には、サーマル・カットアウト装置により自動的に電源が切断されTM504型を保護します。この装置は内部温度が安全動作温度になれば再び電源は復帰します。

TM504型の格納温度は-40℃～+75℃までですが、機器のシャーシが動作温度範囲内に戻ってから電源を投入して下さい。

## 電源投入

### プラグイン

本体を動作させるのにすべてのプラグイン・ホールにプラグインを組み込む必要はありません。必要なプラグインのみ組み込んで下さい。

### 注意

本体の電源スイッチを必ず切ってからプラグインを抜き差しして下さい。電源を入れたままプラグインを抜き差ししますと、プラグインの回路を破損する恐れがあります。

### プラグインの取付け

1. TM504型のコネクタ内にはいつているプラスチックの位置決めスペーサとプラグインのエッジ・コネクタのカット部分が一致しているかどうかを確認します。
2. TM504型のプラグイン・ホールの上下のガイドに沿ってプラグインを差し込み、さらにコネクタにプラグインのエッジ・コネクタがしっかりと固定されるまで押して下さい。プラグインを取りはずす場合には、左下隅にあるつまみを引っ張りそのまま引き抜きます。

### 電源投入方法

この章の最後の項を実行した後、TM504型の右側のPULL ON POWERボタンを引き出します。プラグインの中には独立した電源スイッチを持っているものもあり、通常OUTPUTと前面パネルに書かれています。プラグインを動作させるにはこのボタンを押します。

## システム構成

### 互換性

当社のプラグインは外観上、他のプラグインと類似しています。しかし電気的には互換性がありません。ですから他のシリーズのプラグインと組み合わせができないよう、TM504型のインターフェイス・コネクタのピン6と7に位置決めスペーサがはいつています。(1図参照) TM500シリーズのプラグインはメインのプリント基板上のピン6と7の部分がカットされています。このスペーサとカット部分が一致していることを確認します。

TM500シリーズ・プラグインの正面左下隅のリリース・ラッチの色は白ですので、他のシリーズのプラグインと簡単に識別できます。

### インターフェイス

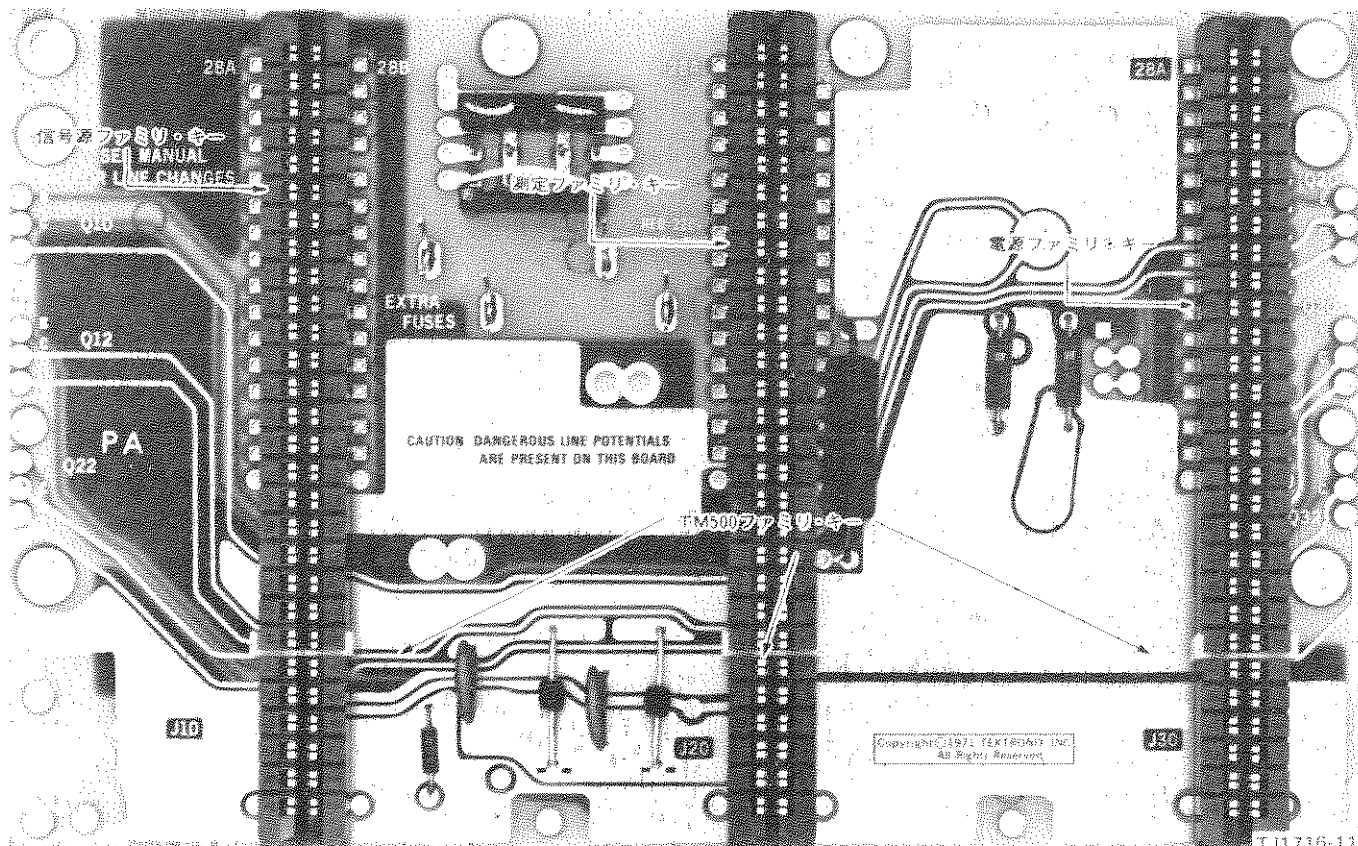
TM500シリーズはプラグイン方式になっていますので多くの異なった機能を持たせることができます。またTM500シリーズを信号源、電源、測定器などいくつかの群に分けることができ、それら同種のプラグインに特定のプラグイン・ホールを割り当てるため、別に位置決めスペーサを挿入することもできます。この位置決めスペーサの追加によって、同種のプラグイン群のみ使用可能なプラグイン・ホールをプログラムすることができます。この方法でTM504型のすべてのプラグイン・ホールに特定の機能を持たせる

ことができます。位置決めスペーサの部品番号は214-1593-02です。

さらにジャンパ線を使うと内部でインターフェイスすることができます。内部コネクタのA面とB面のピン14-28を使って、インターフェイス・ボードの後側をジャンパ線で接続することによりプラグインの信号を内部でやりとりすることができます。本マニュアルのオプション02型の説明の項をご参照下さい。後部インターフェイスの各ピンのI/Oの割り当てについては各プラグインの取扱説明書をお読み下さい。一旦特殊目的用にジャンパ線を接続したら内部インターフェイス・コネクタに位置決めスペーサを取付けて、ジャンパ線の配線に合わせたプラグインの適合性を保持するようにします。

### 後部パネル

後部補助パネルはBNCおよびマルチピン・コネクタを取付けるパンチ穴をあけることができます。オプションで最初から穴があいたものもあります。穴があいていると後から取付けたコネクタや配線で、外部I/O信号をインターフェイス・基板に接続するのに便利です。この特徴によりTM500シリーズ総合テストシステムをベンチ形またはラックマウント形いずれの場合にも非常に汎用性の高いシステムにしています。



2-1図 機能によるキー割当

ermöglicht über das Interface, durch Zugriff von außen an das Interface, eine externe I/O-Steuerung. Durch diese Möglichkeit wird aus der TM 500-Serie ein sehr flexibles modulares Instrumentensystem.

**Option 2.** Mit dieser werkseitig installierten Option verfügt die Versorgungseinheit TM 503 über 25polige Steckverbindungen mit quadratischen Stiften, die mit den Stiften 14A und B bis 28A und B der rückseitigen Steckverbindung der TM 504 verbunden sind. Hierdurch wird das Interface flexibel, da mit speziellen Verbindungsschnüren eine anwenderbezogene Verdrahtung schnell hergestellt werden kann, ohne daß auf der Platine nachträgliche Lötarbeiten durchgeführt werden müssen.

Darüber hinaus beinhaltet die Option noch BNC- und einen 50poligen Stecker auf der Geräte-Rückseite. Diese

Stecker sind nicht verdrahtet, um dem Anwender individuelle Möglichkeiten zu bieten. Ein mitgelieferter Kit verfügt über Stecker, Koaxialkabel und Isolierstege.

## **EINBAU UND ANLEITUNG VOR DER INBETRIEBNAHME**

Beachten Sie die Angaben auf der Rückseite. Stimmt die werkseitig erfolgte Einstellung der Betriebsspannung und Frequenz mit der vorhandenen überein, setzen Sie den Stecker ein. Ist eine Änderung nötig, sollte sich ein qualifizierter Techniker auf die entsprechende Anleitung in diesem Manual beziehen.





# BEDIENUNGSANLEITUNG

## ALLGEMEINES

### Einbau

Die gesamten Einbauanweisungen finden Sie am Ende dieses Kapitels.

### Netzspannung

Die Versorgungseinheit TM 504 muß an ein Lichtnetz mit neutralem oder geerdetem separatem Nulleiter angeschlossen werden. Sie ist nicht für den Anschluß an Zwei- oder Mehrphasennetze geeignet.

### Leistungsaufnahme

Bestückt mit 4 Einschüben nimmt die Versorgungseinheit TM 504 bis zu 220 Watt an einem 220 V Netz auf. Die tatsächliche Leistungsaufnahme hängt von der Kombination der einzelnen Einschübe und deren momentanen Betriebsarten ab.

**Hochleistungs-Einschubfach.** Einige TM 500-Einschübe benötigen ein Hochleistungs-Einschubfach, um ihre maximalen Daten zu erreichen. Um diesen Anforderungen zu genügen hat die Versorgungseinheit TM 504 ein Hochleistungs-Einschubfach. Es handelt sich dabei um das rechte Einschubfach, wenn man von vorne auf die Versorgungseinheit schaut.

**Belastungsmöglichkeiten.** Der optimale Leistungsverbrauch der Versorgungseinheit TM 504 kann durch Planung der Einschubzusammensetzung, der externen Lasten und der resultierenden Verlustwärme bestimmt werden. Optimale Bedingungen werden erhalten durch:

1. Gleiche Belastung aller Einschubkanäle.
2. Verbrauch von soviel Leistung wie möglich in den externen Lasten.
3. Betrieb des Systems in einer Umgebungstemperatur von etwa 25°C.

Jeder Einschub hat Zugriff zu einem, auf ein Kühlblech montierten Leistungstransistorpaar (als Längstransistoren arbeitend). Diese Transistoren, je ein NPN- und PNP-Typ, ermöglichen den Einschüben in Leistungsbereichen zu arbeiten, die nicht erreichbar wären, würde die Verlustleistung innerhalb der Einschübe abfallen.

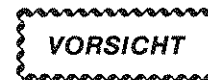
### Betriebstemperaturen

Die TM 504 kann in einem Umgebungstemperaturbereich von 0°C bis 50°C arbeiten. Die Geräte sind durch thermische Abschaltvorrichtungen, die bei hohen Temperaturen ansprechen, wirkungsvoll geschützt. Nach der Wiederherstellung der Betriebstemperatur schaltet sich die TM 504 automatisch wieder ein.

Die Lagerung der TM 504 kann in einem Temperaturbereich von -40°C bis +75°C erfolgen. Die Inbetriebnahme hat jedoch in den vorgeschriebenen Temperaturgrenzen zu erfolgen.

### Versorgungseinheit

Für die Inbetriebnahme der TM 504 Versorgungseinheit ist es nicht zwingend, alle Einschubfächer zu bestücken, es sind nur die Einschübe einzubauen, die für die Anwendung erforderlich sind.



*Die Versorgungseinheit TM 504 sollte vor Einfügen oder Herausnahme eines Einschubs ausgeschaltet werden, da Funkenbildung entstehen und die Schaltkreise beschädigen könnte.*

### Einschubeinbau

1. Überprüfen Sie, ob der Plastiksteg in der rückwärtigen Buchsenleiste der TM 504 Versorgungseinheit so positioniert ist, daß er mit der Aussparung in der Steckerleiste der Einschübe übereinstimmt.

2. Setzen Sie den Einschub in die obere und untere Führung der Versorgungseinheit und schieben Sie ihn bis er in der hinteren Buchsenleiste einrastet. (Entfernen Sie den Einschub durch Ziehen an der weißen Entriegelungsklinke in der linken unteren Ecke jedes Frontpanels.)

### Einschaltvorgang

Zum Einschalten ist der Netzschalter an der Geräte-seite der TM 504 Versorgungseinheit zu ziehen. Einige Einschübe verfügen über einen Schalter, der nach dem Einschalten der TM 504 Versorgungseinheit zu betätigen ist.

## AUFBAU EINES MESSSYSTEMS

### Kompatibilität

Mechanisch sind die Einschübe anderen Tektronix-Produkten sehr ähnlich, jedoch elektrisch nicht kompatibel. Aus diesem Grund besitzt die TM 504 in den Buchsenleisten zwischen den Stiften 6 und 7 Sperriegel, wodurch das Einsetzen eines falschen Einschubes verhindert wird. Siehe Abb. 2-1.

Ein kompatibler Einschub verfügt in seiner Steckerleiste zwischen den Stiften 6 und 7 über eine Aussparung. Diese Kombination von Riegel und Aussparung ist die grundsätzliche Verschlüsselung zwischen Einschüben und Versorgungseinheiten.

Darüber hinaus sind die kompatiblen TM 500-Einschübe durch einen weißen Entriegelungshebel zum Herausnehmen gekennzeichnet.

### Anwenderbezogenes Interface

Durch die Modularität dieses Gerätesystems ergibt sich je nach Kombination eine vielseitige Funktionserfüllung. Die speziellen Funktionen sind in Familien bzw. Klassen zusammengefaßt, denen verschiedene Einschübe zugeordnet sind, z. B. Netzteile, Signalgeneratoren und Meßgeräte. Jeder Einschub verfügt daher je nach

Familienzugehörigkeit über eine weitere Aussparung in seiner hinteren Steckeranschlußleiste, die ihn klassifiziert. Dem Anwender wird hierdurch ermöglicht, durch Einbau von weiteren Isolierstegen seine Versorgungseinheit so zu programmieren, daß die Einschubfächer nur Einschübe mit bestimmten Funktionen aufnehmen. Zusätzliche Isolierstege haben die Tektronix Bestell-Nr. 214-1593-02.

Zur weiteren Spezialisierung des Interface sind Drahtbrücken zu verwenden, die eine Kommunikation der einzelnen Einschubfächer untereinander gestatten. Hierzu sind die Stifte 14 bis 28 der A- und B-Seiten zu verwenden. Eine Beschreibung hiervon ist unter Option 2 dieses Handbuches zu entnehmen. Darüber hinaus ist in jeder Einschubbeschreibung die Stiftbelegung der Steckerleiste zu beachten. Sind solche Zwischenverbindungen hergestellt, so ist es zwingend, auch Isolierstege einzubauen, die die Kompatibilität in der Verdrahtung sicherstellen.

### Rückseite

Auf der Rückseite der Versorgungseinheit TM 504 ist zum Einbau von BNC- und Mehrfachsteckern eine Montageplatte vorgesehen. Ein werkseitig oder vom Anwender vorgenommener Einbau und Anschluß von Steckerverbindungen (Beschreibung siehe unter Option 2)

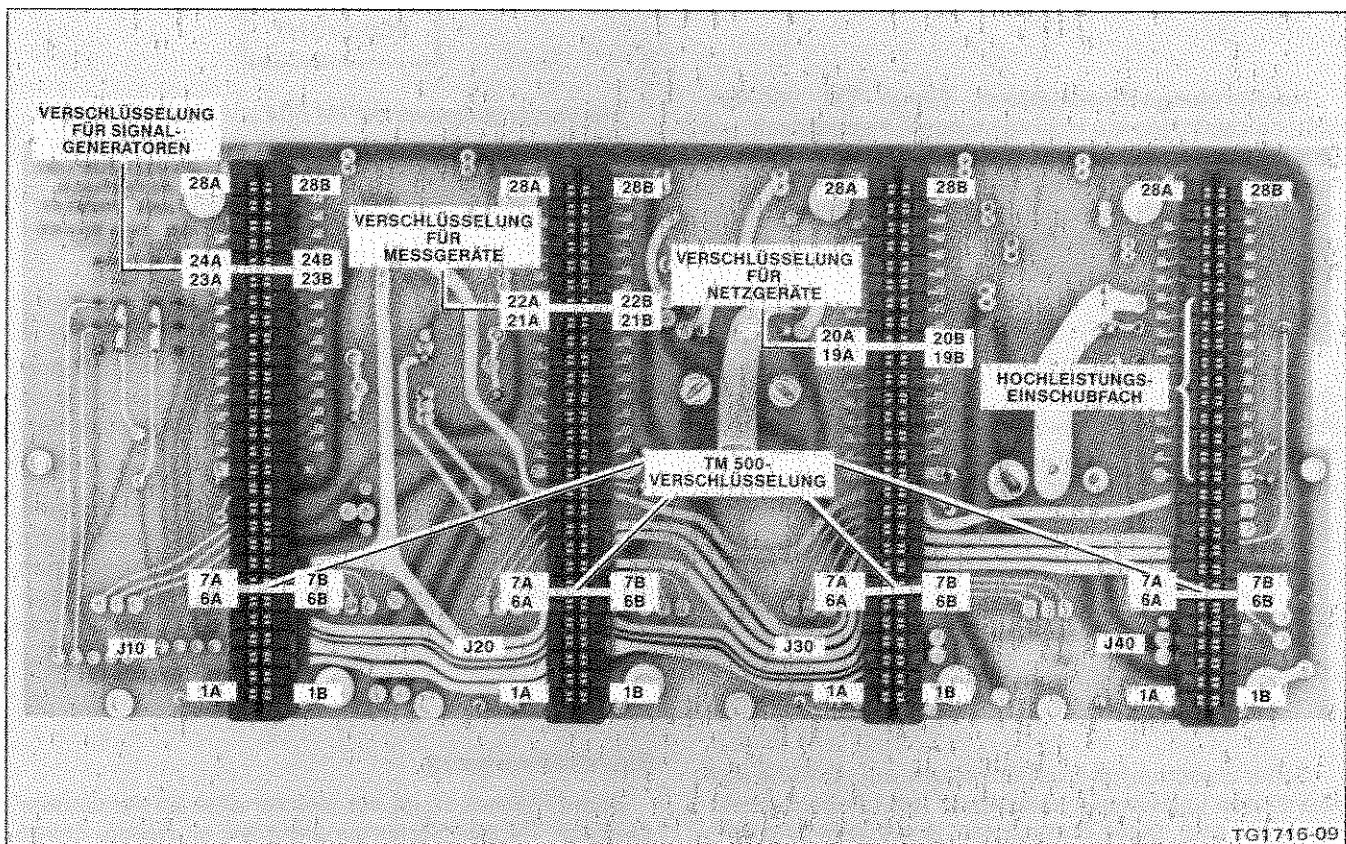


Abb. 2-1. Verschlüsselungsangaben für die Familien-Funktionen. Eine von vielen möglichen Kombinationen.

### オプション02型

オプション02型を指定しますと、インターフェイス・コネクタの後側の14A～28Aおよび14B～28Bのすべてのピンの位置に25ミルの四角いピンが立てられます。これにより付属の角ピン・コネクタ付きワイヤをラジオ・ペンチまたはピンセットを使って簡単に早く配線したり変更したりすることができますのでインターフェイスが容易になります。またジャンパ線のハンダ付けの繰返しによるプリント基板の損傷を防ぐことができます。オプション02型ではさらに後部パネルにBNCコネクタ3個および50ピンコネクタ1個が取り付けられます。これらのコネクタは配線されていませんので、システム設計者が任意に、用途に合わせて配線することができます。ジャンパ線、同軸ケーブル、位置決めスペーサがオプション02型には付属しています。

### 取付けおよび電源投入の手順

後部パネルのマークをチェックして下さい。電源電圧および周波数が、工場出荷時の設定に適合しているならば、プラグインを取付け、底部金具で機器前面を持ち上げて下さい。設定をかえる必要がある場合には、当社フィールド・エンジニアにおたずね下さい。



## **WARNING**

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.



# MAINTENANCE

## GENERAL

### Introduction

This section of the manual is meant to support the entire TM 500 Series family of modules with a general coverage of the most commonly-needed service information pertinent to preventive maintenance, troubleshooting, ordering parts, and replacing components and sub-assemblies.

### Cabinet Removal

#### WARNING

*Dangerous potentials exist at several points throughout the system. When the system must be operated with the cabinet removed, do not touch exposed connections or components. Some transistors have voltage present on their cases. Disconnect power before cleaning the system or replacing parts.*

Four screws on the top secure the cabinet to the TM 504 frame. Remove them and lift the cabinet straight up. Do not operate the system with the cabinet removed any longer than necessary for troubleshooting and calibration. Re-install the cabinet to protect the interior from dust and to remove personnel shock hazards.

### Cleaning

#### CAUTION

*Avoid using chemical cleaning agents which might damage plastic parts. Avoid chemicals containing benzene, toluene, xylene, acetone, or similar solvents.*

**Exterior.** Loose dust may be removed with a soft cloth or a dry brush. Water and a mild detergent may be used. However, abrasive cleaners should not be used.

**Interior.** Cleaning the interior of a unit should precede calibration since the cleaning processes could alter the settings of calibration adjustments. Use low-velocity compressed air to blow off accumulated dust. Hardened dirt can be removed with a soft brush, cotton-tipped swab, or a cloth dampened in a solution of water and mild detergent.

### Preventive Maintenance

Preventive maintenance steps performed on a regular basis will enhance the reliability of the instrumentation systems. However, periodic checks of the semiconductors in the absence of a malfunction are not recommended as preventive maintenance measures. See the semiconductor checking information under Troubleshooting Techniques which follow. A convenient time to perform preventive maintenance is just before instrument calibration.

### Calibration

To ensure accurate signal generation and measurement, the performance of individual units comprising the system should be checked periodically. Refer to the Instruction Manual for each unit for complete calibration and verification procedures.

## TROUBLESHOOTING AIDS

### Introduction

The following is provided to augment information contained elsewhere in this and other TM 500 series family manuals when troubleshooting becomes necessary.

### Circuit Description

Each manual has a section devoted to explaining circuit operating theory. Used with the schematics, this can be a powerful analytic tool.

### Diagrams

Block diagrams and detailed circuit schematics are located on foldout pages in the service section of most of the TM 500 Series family manuals. The schematic diagrams show the component values and assigned circuit reference numbers of each part necessary to the circuit design. Usually the first page of the service section defines the circuit symbols and reference designators used in that particular instrument. Major circuits are usually identifiable by a series of component numbers. Important waveforms and voltages may be shown within the diagrams or on adjoining aprons. Those portions of the circuits located on circuit boards are enclosed with a grey tint outline.

### Cam Switch Charts

Cam switches shown on the diagrams are coded on charts to locate the cam number of the switch contact in the complete switch assembly, counting from the front, or knob end, toward the rear of the switch. The charts also indicate with a solid dot when each contact is closed.

### Circuit Board Illustrations

Line illustrations showing component locations keyed with a grid scheme for each circuit board are usually placed on the back of a foldout page and sequenced as close as possible to an associated schematic. The GRID LOC columns, located near the Parts Location Grid, keys each component to easy location on the board.

### Component and Wiring Color Codes

Colored stripes or dots on electrical components signify electrical values, tolerances, etc., according to EIA standards. Components not color-coded usually have information printed on the body. The wiring coding follows the same EIA standards with the exception of the ac power cord of the Power Modules. It is coded like this:

#### Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

### Testing Equipment

Generally, a wide-band oscilloscope, a probe, and a multimeter are all that is needed to perform basic waveform and voltage checks for diagnostic purposes. The calibration procedures in the manual for each plug-in module list specific test equipment and the features necessary to adequately check out that particular module.

## TROUBLESHOOTING TECHNIQUES

### Introduction

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding to extensive troubleshooting.

### Control Settings

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of the manual for the instrument involved.

### System and Associated Equipment

Before proceeding with troubleshooting the TM 500 Series system, check that the instruments in the system are operating correctly. Check for proper interconnection between the power module and the plug-in modules. Check the line voltage at the power source. Check that the signal is properly connected and that the interconnecting cables and signal source are not defective.

The associated plug-in modules can be checked for proper operation quickly by substituting other like units known to be operating properly. If the trouble persists after substitution, then the power module is probably at fault. Moving a properly operating plug-in from compartment to compartment will help determine if one or more compartments have a problem.

### Visual Check

Inspect the portion of the system in which the trouble is suspected. Many troubles can be located by visual clues such as unsoldered connections, broken wires, damaged circuit board, damaged components, etc.

### Instrument Calibration

Check the calibration of the suspected plug-in module or the affected circuit if the trouble is obviously in a certain circuit. The trouble may only be a result of misadjustment or may be corrected by re-calibration. Complete calibration instructions are given in the manual for each instrument in the system.

### Circuit Isolation

Note the trouble symptoms. These often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by making waveform and voltage measurements.

Incorrect operation of all circuits often means trouble in the power supplies. Using a multimeter, check first for correct voltages of the individual regulated supplies according to the plug-in module schematics and calibration procedures. Then check the unregulated supplies of the power modules. Defective components elsewhere in the instruments can appear as power supply problems. In these instances, suspected circuits should be disconnected from apparently bad power supplies one at a time to narrow the search.

### Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on the schematic or in the calibration procedures. Such



waveforms and voltage labels are typical indications and will vary between instruments. To obtain operating conditions similar to those used to take these readings, refer to the first diagram in the service sections.

### Component Checking

If a component cannot be disconnected from its circuit, then the effects of the associated circuitry must be considered when evaluating the measurement. Except for soldered-in transistors and integrated circuits, most components can be lifted at one end from the circuit board.

**Transistors and IC's.** Turn the power switch off before removing or replacing any semiconductor.

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions. A suction-type desoldering tool must be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC(s). Operating waveforms, logic levels, and other operating information for the IC's are given in the circuit description information of the appropriate manual. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin in-line IC's is with an integrated circuit test clip. This device also doubles as an extraction tool.

**Diodes.** Do not use an ohmmeter that has a high internal current. High currents may damage the diode.

A diode may be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 mV, and 3 V, the resistance should be very high in one direction and very low when the leads are reversed.

**Resistors.** Check the resistors with an ohmmeter. Resistor tolerances are given in the Electrical Parts List in every manual. Resistors do not normally need to be

replaced unless the measured value varies widely from the specified value.

**Capacitors.** A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale. Use an ohmmeter that will not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacity meter, or by checking whether it passes ac-signals.

## PARTS ORDERING AND REPLACING

### Ordering

**Obtaining Replacement Parts.** Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix Inc., please check the electrical parts list for the proper value, rating, tolerance and description.

**Special Parts.** Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc., to our specifications. Most of the mechanical parts used in this system have been manufactured by Tektronix, Inc. Order all special parts directly from the local Tektronix Field Office or representative.

**Ordering Procedure.** When ordering replacement parts from Tektronix, Inc., please include the following minimum information:

1. Instrument Type (PS 501, SG 502, DC 501, etc.)
2. Instrument Serial Number (For example, B010251)
3. A description of the part (if electrical include the circuit number)
4. Tektronix part number.

Please do not return any instruments or parts before receiving directions from Tektronix, Inc.

A listing of Tektronix Field Offices, Service Center and Representatives can be found in the Tektronix Product Catalog and Supplements.

## Replacing

The exploded view drawings associated with the Mechanical Parts List, located to the rear of most manuals, may be especially helpful when disassembling or reassembling individual components or sub-assemblies.

**Circuit Boards.** If a circuit board is damaged beyond repair, either the entire assembly including all soldered-on components, or the board only, can be replaced.

To remove or replace a board, proceed as follows:

1. Disconnect all leads connected to the board (both soldered lead connections and solderless pin connections).
2. Remove all screws holding the board to the chassis or other mounting surface. Some boards may be held fast by plastic mounting clips around the board edges. For these, push the mounting clips away from the circuit board edges to free the board. Also, remove any knobs, etc., that would prevent the board from being lifted out of the instrument.
3. Lift the circuit board out of the unit. Do not force or bend the board.
4. To replace the board, reverse the order of removal. Use care when replacing pin connectors. If forced into place incorrectly positioned, the pin connectors may be damaged.

**Transistors and IC's.** Transistors and IC's should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instruments. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

Replacement semiconductors should be of the original type or a direct replacement. Figure 3-1 shows the lead configurations of the semiconductors used in this instrument system. When removing soldered-in transistors, use a suction-type desoldering tool to remove the solder from the holes in the circuit board.

An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available,

use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Try to avoid having one end of the IC disengage from the socket before the other end.

To replace one of the power transistors mounted on the Power Module chassis adjacent to the interface circuit board, first unsolder the leads. Then, loosen the nuts which clamp the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use a mica washer on the metal tab to increase heat transfer from the transistor to the chassis.

## Static-Sensitive Components

### CAUTION

*Static discharge can damage any semiconductor component in this instrument.*

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 3-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.
3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Do not slide the components over any surface.

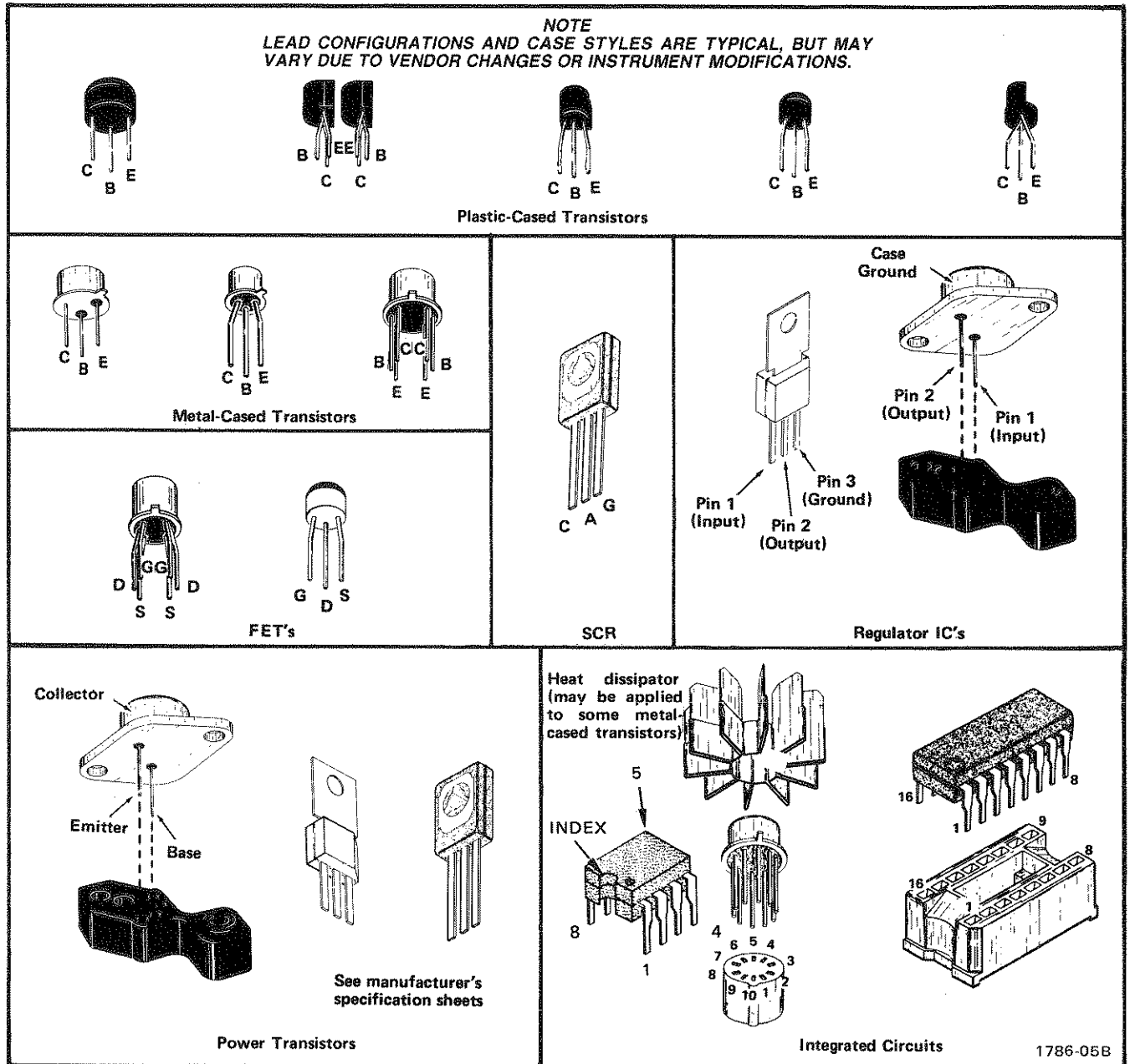


Fig. 3-1. Semiconductor device lead configurations found in the TM 500 family.

8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction type or wick type desoldering tools.

### Test Equipment

Before using any test equipment to make measurements on static-sensitive components or assemblies, be certain that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

**Table 3-1**  
**RELATIVE SUSCEPTIBILITY TO**  
**STATIC DISCHARGE DAMAGE**

Semiconductor Classes	Relative Susceptibility Levels <sup>a</sup>
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear Microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

<sup>a</sup> Voltage equivalent for levels:

1 = 100 to 500 V    4 = 500 V    7 = 400 to 1000 V (est.)  
 1 = 200 to 500 V    5 = 400 to 600 V    8 = 900 V  
 3 = 250 V    6 = 600 to 800 V    9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)

**Interconnecting Pins.** To replace a pin that is mounted on a circuit board, first disconnect any pin connectors. Then, unsolder the damaged pin and pull it out of the board with a pair of pliers. Be careful not to damage the wiring on the board with too much heat. Ream out the hold in the circuit board with a 0.031-inch drill. Remove the ferrule from the new interconnecting pin and press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin and solder it in. If the old pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins.

**NOTE**

*A pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.*

**Cam Switches.** Repair of cam-type switches should be undertaken only by experienced maintenance personnel. Switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch.

For assistance, contact your local Tektronix Field Office or representative.

**NOTE**

*A cam-type switch repair kit including necessary tools, instructions, and replacement contacts is available from Tektronix, Inc.*

The cam-type switches consist of rotating cam drums which are turned by front-panel knobs, and sets of spring-leaf contacts mounted on adjacent circuit boards. The contacts are actuated by lobes on the cams. These switches can be disassembled for inspection, cleaning, repair, or replacement as follows:

1. Remove the screws which hold the metal cover on the switch, and lift the cover off the switch. The switch is now open for inspection or cleaning.
2. To completely remove a switch from the circuit board, first remove any knobs or shaft extensions. Loosen the coupling at the potentiometer at the rear of the switch, and pull the long shaft out of the switch assembly.
3. Remove the screws (from the opposite side of the circuit board) that holds the cam drum to the board.
4. To remove the cam drum from the front support block, remove the retaining ring from the shaft on the front of the switch and slide the cam drum out of the support block. Be careful not to lose the small detent roller.
5. To replace defective switch contacts, follow the instructions given in the switch repair kit.
6. To re-install the switch assembly, reverse the above procedure.

**Pushbutton Switches.** The pushbutton switches are not repairable and should be replaced as a unit if defective. Use a suction-type desoldering tool to remove solder from the circuit board when removing these switches.

**Incandescent Bulbs.** Most of these light bulbs are mounted on the sub-panel using plastic sleeve stand-offs. Unsolder the lead wires and pull the bulb out of the sleeve from the rear of the sub-panel.

**Light-Emitting Diodes.** LED's used as indicators are mounted on the sub-panels with plastic sleeve sockets

similar to the incandescent bulb mountings or they are soldered directly to a sub-assembly and so mounted that they protrude through holes in the panel. In these cases, the sub-assembly must be exposed and the anode and cathode lead orientations carefully noted before unsoldering the defective LED. See Fig. 3-2 for LED lead identifying information.

**Power Transformer.** Replace the transformer only with a Tektronix direct replacement transformer. Refer to the exploded view drawing at the rear of the Power Module manuals for disassembly of the rear panel to expose the power transformer. Refer to the schematic diagram color-coding information for correct wiring. After replacement check out the power supply voltages before installing a plug-in module.

### Option 2

This factory installed option adds 25-mil square pin connectors to the rear of the interconnecting jacks at all pin locations from pins 14A and B. This will keep the interface flexible by making it easy and fast to change customized wiring using prepared wires with square pin receptacles. It also protects the circuit board from damage by repeating soldering and unsoldering of jumper wires. This option also adds six BNC connectors and one 50-pin connector to the rear panel. These connectors are not prewired in order to give a system designer as much flexibility as possible. Instead, prepared jumpers, coax cables, and interconnection jack barriers are included in the TM 504.

### Option 7

The following described bus wires and keys are added to the connector boards of the TM 500-Series Power Module to provide rear interface connections between the TM 500 Counters containing Option 7, the TR 502, and the SW 503.

**Bus Wires.** Six-conductor ribbon cable (Tektronix Part No. 175-0829-00) is used to make bus runs between the following points:

#### TM 504

B14 on J10, J20, and J30  
 B15 on J10, J20, and J30  
 B16 on J10, J20, and J30  
 B17 on J10, J20, and J30  
 B18 on J10, J20, and J30  
 A18 on J10, J20, and J30

**Barrier Keys.** Plastic barrier keys (Tektronix Part No. 214-1593-02) are inserted between pins 21 and 22 on J10 between pins 23 and 24 on J20 and between pins 17 and 18 on J30.

Once the above bus connections are made and barrier keys inserted, the three connectors so changed are system dedicated and the three slots should only be used for system-dedicated plug-ins.

### System Design Directions

1. Plan the plug-in location based on the front-panel controls and operator convenience as well as interface connections.
2. Plan the wiring between interconnecting jacks and to the rear panel connectors carefully before starting assembly. A mating rear panel 50-pin connector and cover are provided for external cabling.

#### NOTE

*There are no pin assignments for the rear panel connectors, due to the great variety of possible connections.*

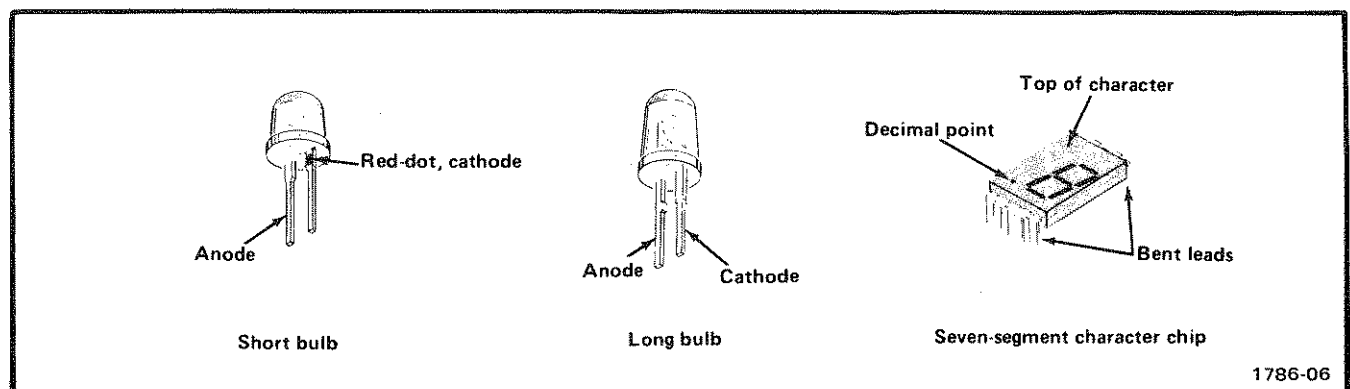


Fig. 3-2. Light emitting diode (LED) lead orientation illustration.

When high frequency or fast digital signals are involved, plan the wires so as to minimize crosstalk. Make allowance for the possible need to make auxiliary ground connections.

The 50-pin rear panel connector may be easier to connect if it is removed from the rear panel and remounted after connections are made. Remove the top rear cabinet piece for ease of access.

If more than 50 pins are needed, an AMP HD-22 series connector with 104 pins may be mounted in the same cut out. It is suggested that these parts be obtained directly from AMP Inc., Harrisburg, PA or their distributors. For further application information, contact Tektronix' TM 500 Marketing Group, Beaverton, OR.

3. Pin assignments for individual plug-ins will be found in the appropriate instruction manual.

4. Install an interconnection jack barrier at the appropriate location on the interconnection jack. Refer back to operating instructions for keying assignments for family functions.

5. Select and install the wires (hook-up or coax) following the guidelines in the Wire Use part of these instructions.

6. Wires or cables which may be at large potential differences should be dressed or bundled so as to avoid contact. Keep all interface wiring away from the TM 506 primary line wiring.

7. There is an empty cut-out which will mount the standard IEC digital interface connector. The connector is not supplied with this option.

### Wire Use

1. Hook up wire with square-pin receptacle on both ends. These may be used for low frequency or dc circuits where impedance levels and crosstalk are not a problem. The wire is supplied in four lengths for connection between compartments (adjacent or nonadjacent) or between a compartment and the rear panel. For connection to the rear panel, cut to length then tin and solder the end going to the rear panel.

2. Coaxial wire with square pin receptacles on both ends. These are used for connections which require shielding or which must maintain a 50  $\Omega$  characteristic impedance. The outer conductor should be connected to either chassis ground or circuit ground. Plug-in lines

which require coax leads usually have a specified ground pin assignment. If necessary, establish auxiliary ground connections at the appropriate wire ends. The coaxial wire is supplied in four lengths for connection between compartments (adjacent or non-adjacent) or between a compartment and the rear panel. For connection to the rear panel, cut to length then tin and solder the end going to the rear panel.

### Packaging Information

A list of standard accessories (and part numbers) is located in the Replaceable Mechanical Parts list.

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing owner (with address) and the name of an individual at your firm that can be contacted. Include the complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than 6 inches more than the instrument dimensions. Cushion the instrument by tightly packing 3 inches of dunnage or urethane foam between carton and instrument on all sides. Seal the carton with shipping tape or an industrial stapler.

The carton test strength for this instrument is 275 pounds per square inch.

## INSTALLATION PROCEDURE

Due to regional variations in the power source line voltage the TM 504 has selectable transformer primary taps. The taps are located on the interface board and are implemented by using the appropriate selector block. See Figs. 3-3, 3-4, and 3-5.

Table 3-2 shows which position the selector block should be in for specific line voltages. The brown selector block should be used for nominal line voltages of 120 V, and the red selector block for 220 V nominal line voltages. For example, if the power source is 120 V nominal and found to be exactly 115 V then the brown selector should be used on the high (H) primary taps.

**Table 3-2**  
**UNIVERSAL TRANSFORMER**

Line Selector Block Position	Regulating Ranges	
	120 Volts Nominal	220 Volts Nominal
L	90 VAC to 110 VAC	180 VAC to 220 VAC
M	99 VAC to 121 VAC	198 VAC to 242 VAC
H	108 VAC to 132 VAC	216 VAC to 264 VAC
Line Fuse Data	3A slow-blow	1.6 slow-blow

To determine how the TM 504 is set and if a change is necessary, the following procedure should be used:

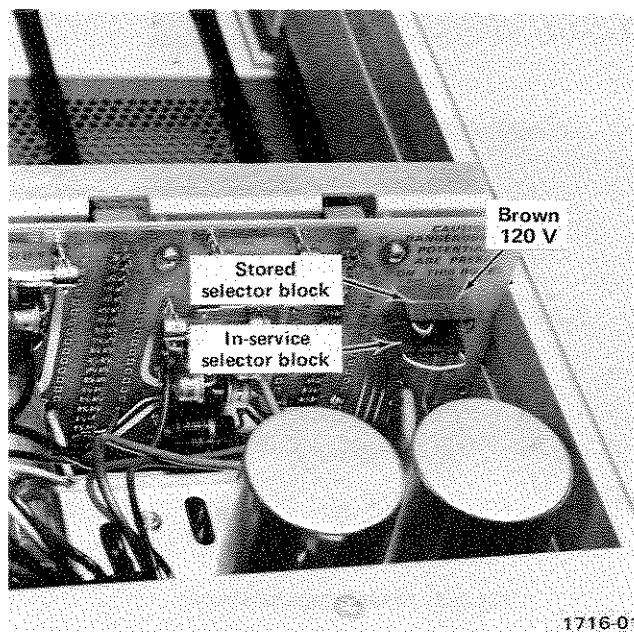
1. Determine what the actual line voltage of the power source is and note.
2. Remove the six hold-down screws on the top of the dust cover cabinet and lift off.
3. Locate and determine the position of the line selector block.
4. Using the above noted line voltage and Table 3-2, determine if a change is necessary.
5. If a change is necessary place the selector block on the appropriate taps.
6. Replace the cabinet and hold-down screws.
7. Check the SET FOR VAC indicator where the power cord enters the back panel (see Fig. 3-6), using the settings given below.

For 120 V nominal:

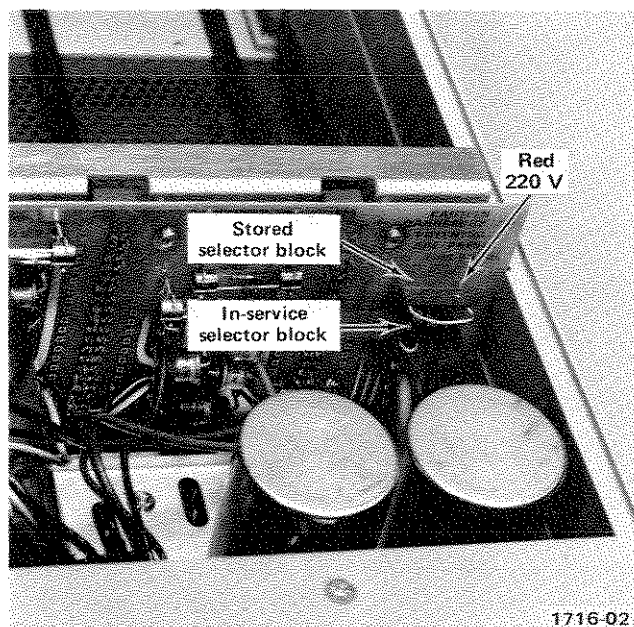
L — 100  
M — 110  
H — 120

For 220 V nominal:

L — 200  
M — 220  
H — 240



**Fig. 3-3. 220 V Selector block in service.**



**Fig. 3-4. 120 V Selector block in service.**

Using the example given above, the indicator would be set at 120. The indicator is set by pulling the numbered ring away from the instrument, turning so that the appropriate number will appear in the slot, and pressing towards the instrument.

8. The instrument is now ready for use.

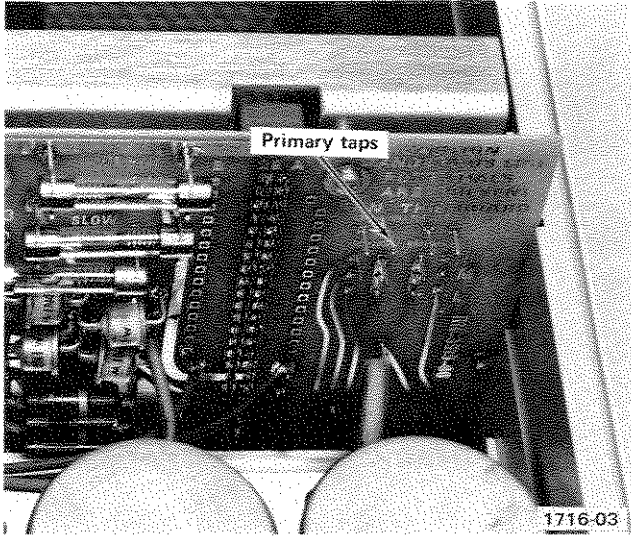


Fig. 3-5. Primary taps locations.

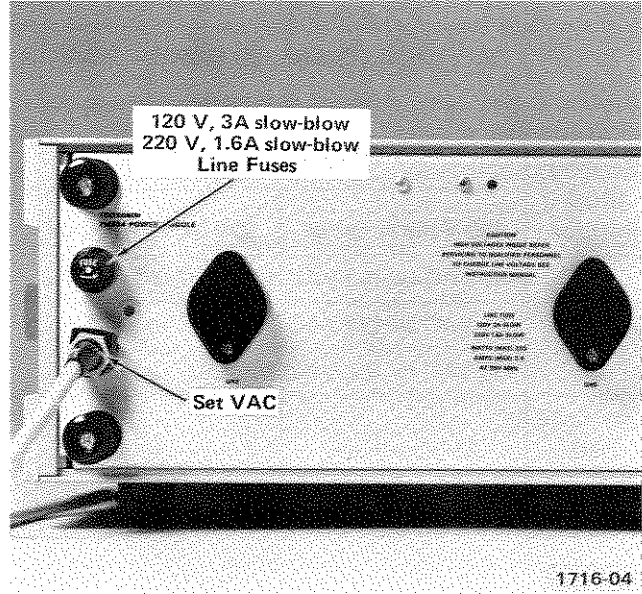


Fig. 3-6. Line voltage set indicator.



# OPTIONS

**Option 2.** Information about this option may be found in the following sections:

Section 2 - Operating Instructions

Section 3 - Maintenance

Section 7 - Replaceable Mechanical Parts

**Option 7.** Information about this option may be found in Section 3 - Maintenance.



# REPLACEABLE ELECTRICAL PARTS

## PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

## SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number  
00X Part removed after this serial number

## ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

## ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
07256	SILICON TRANSISTOR CORP. DIV OF BBF INC.	KATRINA RD - KSC WAY	CHELMSFORD, MA 01824
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71400	BUSSMAN MFG., DIVISION OF MCGRAW- EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81439	THERM-O-DISC, INC.	1320 S MAIN, P O BOX 1538	MANSFIELD, OH 44907
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377