040-0821-03

M31573, M23958,
M33052

BLANK PLUG-IN WITHOUT CIRCUIT BOARD

For TEKTRONIX® TM 500/5000 Series Power Modules

All Serial Numbers

This modification kit contains all of the mechanical parts (excluding the circuit board) necessary to construct a blank PLUG-IN for use in any TM 500/5000 Series Power Module.

This kit also contains information about the interface connections to the Power Modules.

Even though the TM 500 Series blank plug-ins will operate in the new TM 5000 Series Power Modules, no provision is made to connect any circuitry in the blank plug-ins to the GPIB bus.

If your TM 5000 system requires customized circuitry, it is recommended that you use a 50M70 Programmable Development card in an MI 5010 Multifunction Interface. Approximately 20 square inches of usable circuit board is available in the 50M70 Programmable Development Card, for customized circuitry.

3-18-83
Supersedes: 6-4-81

PARTS INCLUDED IN MODIFICATION KIT:

Quantity	Part Number	Description
1 ea.	105-0718-01	Bar, Latch release
1 ea.	105-0719-00	Latch, Plug-in Retaining
1 ea.	200-1273-02	Subpanel, back
4 ea.	+213-0146-00	Screw, thread forming #6 x 0.313 PH
4 ea.	+213-0229-00	Screw, thread forming #6 x 0.375 FH
1 ea.	213-0254-00	Screw, 2-32 x 0.250 FH
1 ea.	214-1061-00	Spring, electrical ground
1 ea.	333-1483-03	Panel, front
2 ea.	337-1399-00	Shield, electrical (side covers)
1 ea.	366-1690-01	Knob, Latch (plain)
1 ea.	386-2402-05	Subpanel, front
1 ea.	426-0724-00	Frame section, bottom
1 ea.	426-0725-00	Frame section, top

NOTE

To facilitate assembly, BE SURE TO USE A POZIDRIV screwdriver when installing the front panel and rear subpanels.

TM 500/TM 5000 BLANK PLUG-IN CUSTOM CIRCUITRY

Use of this blank plug-in with your custom circuitry requires the design and fabrication of a circuit board or other mounting provisions for a power supply and interface circuitry. Review of TM 500/5000 Series power module and TM 500/5000 Series plug-in manuals will provide good examples of proven circuits. If you require further information you should consult TEKTRONIX publication A-3186 entitled "Suggested Power Supply Circuits" and the publications of the following semiconductor manufacturers.

1. Linear Integrated Circuits Data Book, Motorola Semiconductor Products, Inc.

2. The Linear Integrated Circuits Data Catalog, Fairchild Semiconductor.

3. Application Note 312, Fairchild Semiconductor.

4. Application Notes AN-473, AN-480, AN-498, AN-499, and AN-500, Motorola Semiconductor Products, Inc.

5. Voltage Regulator Handbook, National Semiconductor Corporation.

6. Linear Integrated Circuits (file 411) (CA 7800) RCA.

7. Linear Integrated Circuit Voltage Regulator, Texas Instrument, Inc.

Applications notes describing customer built TM 500 Series plug-ins will be released from time to time. For this and other technical information, contact your local TEKTRONIX Field Office.

TM 500/TM 5000 Series Power Modules form the exterior package for a variety of instruments built in a standard plug-in format. In addition to basic elements, the power module allows custom interconnection between plug-ins in a type TM 503, TM 504, TM 506, TM 515, TM 5003, or TM 5006 Power Module, or to external devices in all TM 500/TM 5000 Series Option 02, or TM 515 Option 05 Power Modules via rear panel connectors.

Several major power supply components are located in the power module.

1. Primary power circuits: line cord; power switch; line fuse; line voltage selector; power transformer with option for domestic or export primaries.*

2. Secondary power circuits:

   a. Two independent, floating secondary windings for each plug-in, with a voltage suitable for providing regulated DC up to 20 volts.

   b. DC (rectified and filtered only in TM 500 Series power modules) suitable for regulation to plus and minus 20 volts (or less). The common for these supplies is tied to chassis ground in the power module.

   c. DC (rectified and filtered only in TM 500 Series power modules) suitable for regulation to +5 V.

   d. 17.5 VAC (derived from the same windings used for c above in the TM 500 Series power modules). This ac voltage is supplied for the purpose of generating -5 V in the plug-in if a negative supply is preferred.

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*TM 501's below SN B072668 and TM 503's below SN B031680 had a domestic 60 Hz 115 VAC power transformer. Parts Replacement Kits 050-0643-XX and 050-0644-XX are available to replace the single standard domestic transformers with the dual standard transformers in the early TM 501 and TM 503 respectively.

3. Series-pass transistors -- Two devices for each plug-in, accessible via the interface connector. Devices are one each Motorola MJE 2801 NPN and one each Motorola MJE 2901 PNP. Power modules with high-power compartments have one each 2N3055 NPN and one each MJ2955 PNP transistors. These devices, and their heat-sinks are in the power module, allowing more heat to be generated by other circuits in the plug-in.

It should be noted that there are "penalties" associated with the use of any of the ac sources. These are the additional cost, weight and space requirements of rectifiers and filters in the plug-in. The advantages are the ability to float, stack, double, or further transform, etc.

THERMAL MANAGEMENT

Besides the current ratings of the various supplies, there are other considerations in determining whether or not all the resulting power may be safely used. Hot spots, general distribution of heat, and component temperature ratings all must be taken into account.

The three major areas of concern are:

1. Series-pass transistors in the power module.

2. Plug-in modules.

3. External loads.

External loads are obviously the easiest to handle, since the heat generated is external to the power module or the plug-in. It should be remembered that conventional series-pass regulator circuits shift power from the load to the pass device when the output voltage is reduced. This occurs whether the voltage to the load is reduced by means of the output voltage control, or when current-limiting occurs. Foldback current limiting reduces pass dissipation by virtue of switching to a lower current level during limit conditions, but this approach may involve latch conditions when the load returns to normal; also, it prohibits use of the supply as a current source.

Under most operating conditions, the power module series pass transistor should be held to 7.5 watts in the TM 500 Series and 10 watts in the TM 5000 Series.

The interior temperature of a plug-in will rise about 3°C/watt at an input power of 5 watts, evenly distributed. At the 12 watt level, the rise is about 2.5°C/watt. The actual temperature, of course, depends on the temperature of the air surrounding the power module, its circulation and the amount of heat being dissipated in other parts of the system.

For most circuits, a plug-in's internal dissipation should be held to 10-12 watts. Temperature rise can be reduced considerably by ventilating the plug-in rails. (Introducing holes or cutouts in the rails.) A decision to use ventilated rails should take into account cost, strength, and EMI or crosstalk considerations.

TABLE 1

POWER SUPPLY RATING SUMMARY

Characteristic	TM 500	TM 5000
SUPPLY	+33.5 V dc	+26 V dc
Tolerance[1]	+23.7 to +40.0 V	+23.7 to +23.8 V
PARD[2]	≤ 2.5 V p to p[3]	≤ 2.5 V p to p[4]
Maximum Load	350 mA	1 A per compartment
Maximum Load $\frac{di}{dt}$	10 mA/μs[5]	10 mA/μs[6]
SUPPLY	-35.5 V dc	-26 V dc
Tolerance[1]	-23.7 to -40.0 V	-23.7 to -28.3 V
PARD[2]	≤ 2.5 V p to p[7]	≤ 2.5 V p to p[8]
Maximum Load	350 mA	1 A per compartment
Maximum Load $\frac{di}{dt}$	10 mA/μs[9]	10 mA/μs[10]

TABLE 1

POWER SUPPLY RATING SUMMARY

(cont)

Characteristic	TM 500	TM 5000
SUPPLY	+11.5 V dc[11]	+8 V dc
Tolerance[1]	+7.6 to +16.0 V	+7.6 to +8.5 V
PARD[2]	≤ 2.5 V p to p[3]	≤ 600 mV p to p[4]
Maximum Load		
Std Compartment	1.3 A	3 A per compartment
High Power	4.0 A	3 A per compartment
Maximum Load $\frac{di}{dt}$	20 mA/μs[5]	20 mA/μs[6]
SUPPLY	25 V ac (2 each)	25 V ac (2 each)
Range	25.0 V rms +10%, -15%	26.0V rms +10%, -15%
Maximum Load		
Std Compartment	1 A rms per winding (≃ 400 mA dc)	1 A rms per winding (≃ 400 mA dc)
High Power	2.5 A rms per winding (≃ 1 A dc)	2.5 A rms per winding (≃ 1 A dc)
Max Floating V	350 V peak	350 V peak from chassis ground

NOTE

Typically the use of the ac supplies to develop dc supplies results in dc current of 1/2 to 1/2.5 of the ac rms rating.

TABLE 1

POWER SUPPLY RATING SUMMARY

(cont)

Characteristic	TM 500	TM 5000
SUPPLY	17.5 V ac[11]	17.5 V ac
Range	20.5 V +10%, -20%	20.5 V +10%, -20%
Maximum Load		350 mA per compartment
Std Compartment	30 VA	
High Power	95 VA	
MAXIMUM PER COMPARTMENT POWER DRAW FROM POWER MODULE[12]		
Std Compartment	35 W dc or 50 VA_{ac}	30 W dc or 50 VA_{ac}
High Power	45 W dc or 125 VA_{ac}	30 W dc or 125 VA_{ac}
COMBINED POWER DRAW SHARING LIMITATION[4]		
Std Compartment	VA_{ac} + 2.1 ($watts_{dc}$) ≤ 75	VA_{ac} + 2.67 ($watts_{dc}$) ≤ 100
High Power	VA_{ac} + 2.1 ($watts_{dc}$) ≤ 150	VA_{ac} + 2.67 ($watts_{dc}$) ≤ 150

NOTE

In TM 500 power modules, the 11.5 V dc supply is developed from the 17.5 VAC supply. Therefore, any current draw from the 17.5 VAC supply subtracts from the available current in the 11.5 vdc supply. In the TM 5000 power modules, the +8 V supply is separate from the 17.5 VAC supply.

NOTE

The combined power draw in each compartment must not exceed the specified limits. Use the formula in the table for appropriate power modules to determine the combined power draw

NOTE (cont)

for a compartment, as follows: multiply the voltage of each ac winding by its estimated rms current. (To estimate the winding rms current, multiply the dc current measured after the rectifiers by 2 to 2.5.) Total the results for all the ac windings used. Next, measure the current used from each dc supply and multiply the current by the supply's corresponding nominal voltage. Total all the dc watts for the compartment and multiply by 2.1 or 2.67 (depending on power module type). Add this result to the total for the ac supplies. The resulting figure is the total power draw for the compartment in VA. This value must not exceed the limits specified in the table for combined power draw sharing limitation.

TABLE 1

POWER SUPPLY RATING SUMMARY

(cont)

Characteristic	TM 500	TM 5000
MAXIMUM RECOMMENDED PLUG-IN POWER DISSIPATION		
One-wide	10 to 15 W	15 W
Two-wide	25 to 35 W	35 W

[1] Worst case: Low line with full load, and high line with no load. These limits include PARD.

[2] Periodic and Random Deviation. See National Electrical Manufacturers Association (NEMA) Standards Publication No. PY1-1972.

[3,7] See graph 1 for maximum pk-to-pk ripple vs frequency that may occur.

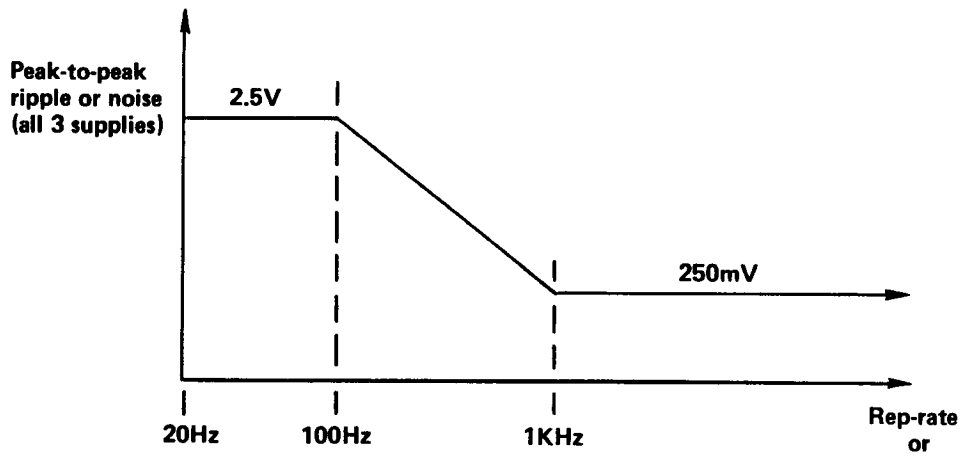
[4,8] See graph 3 for maximum pk-to-pk ripple vs frequency that may occur.

[5,9] See graph 2 for maximum load change vs repetition rate allowed.

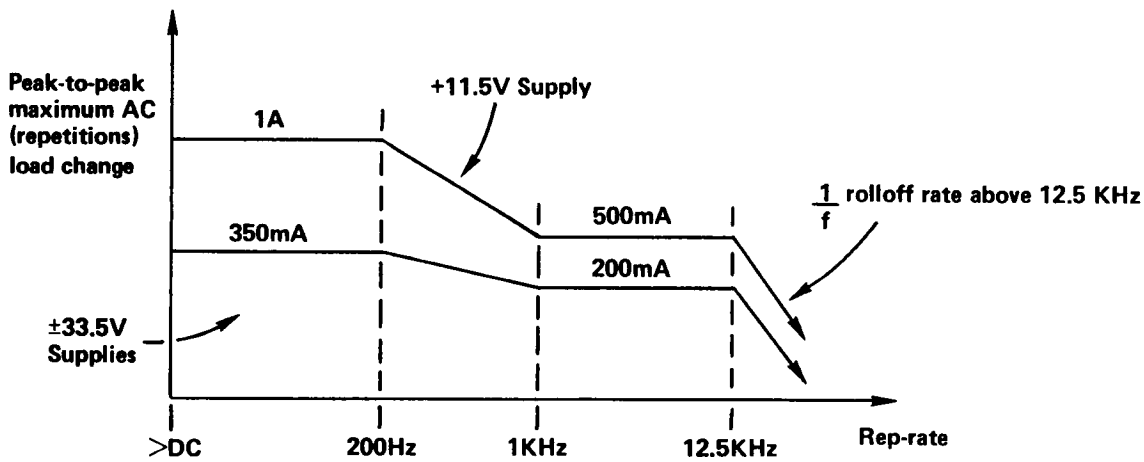
[6,10] See graph 4 for maximum load change vs repetition rate allowed.

[11] Floating in High Power compartment, 350 V peak.

[12] At nominal line voltage.

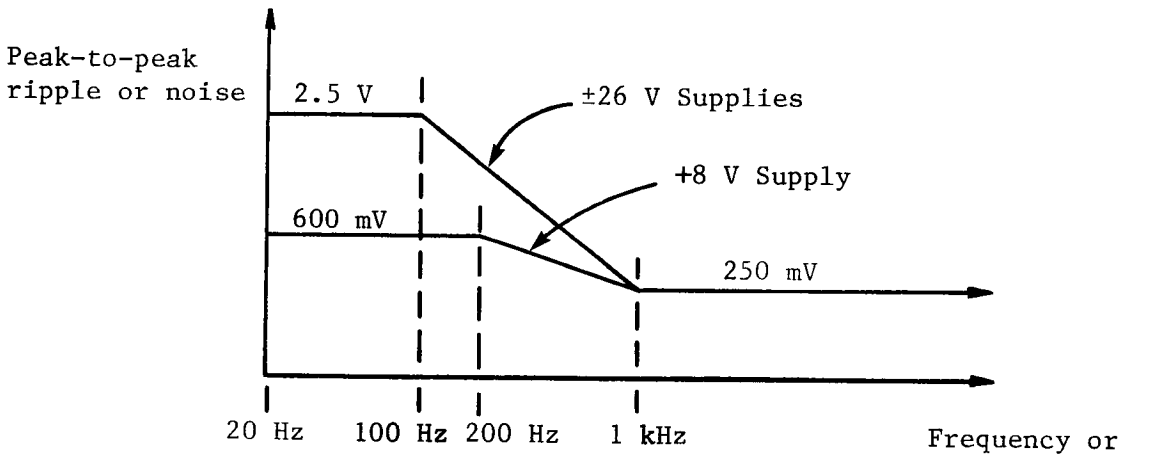


GRAPH 1

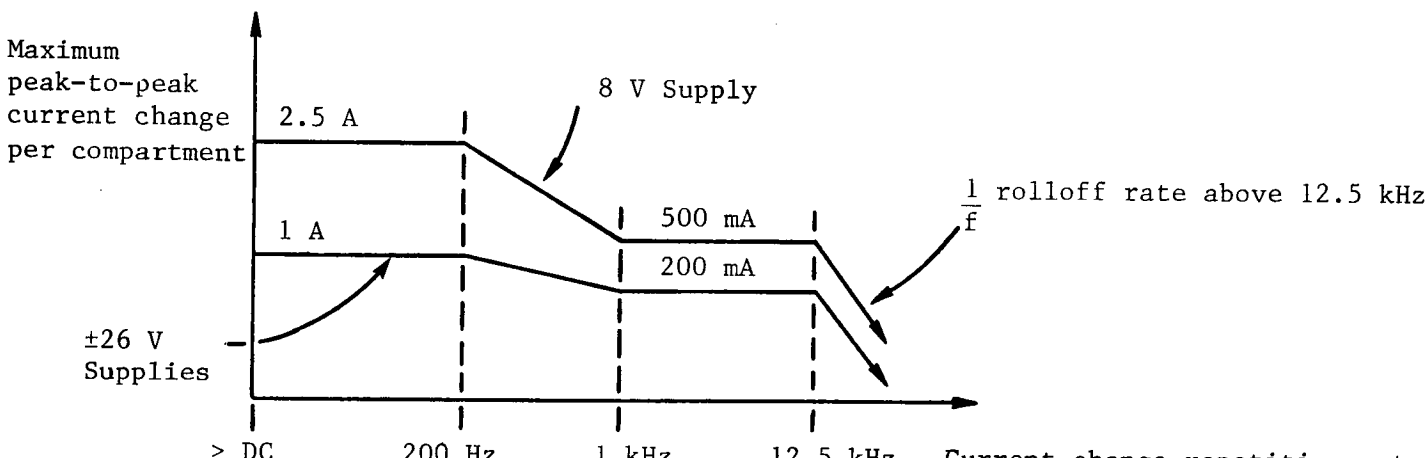


GRAPH 2

ENGINEERING REFERENCE INFORMATION



GRAPH 3



GRAPH 4

Any unit designed to take advantage of the extra current available in the high power compartment may cause damage when plugged into a standard compartment. The best protection scheme is to mount a switch on the plug-in circuit board, which will be actuated by the power module. A suitable switch is Tek PN 260-1310-01; however, the current rating of the switch is such that it is best to use it in a low-current controlling circuit rather than using it directly in the high-current path.

Mount the switch so that the tip of the plastic actuator is even with the end of the circuit board in its normal (extended) position. The plastic actuator should be next to contact 24A on the circuit board. Spacing from the surface of the board should be such that the opening in the power module shield (at the lower-power compartments) leaves the switch in the extended position. Inserting the plug-in in the high-power compartment should actuate the switch.

CLEANING INSTRUCTIONS

CAUTION

Avoid using chemical cleaning agents which might damage plastic parts. Avoid chemicals containing benzene, toluene, zylene, 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, dry brush, cottom-tipped swab, or a cloth dampened in a solution of water and mild detergent.

NOTE

Since plastic parts tend to become brittle at low temperatures, assemble the latch knob and release bar outside of the plug-in several times, before attempting to install it in the plug-in, to prevent breakage of the latch knob during assembly.

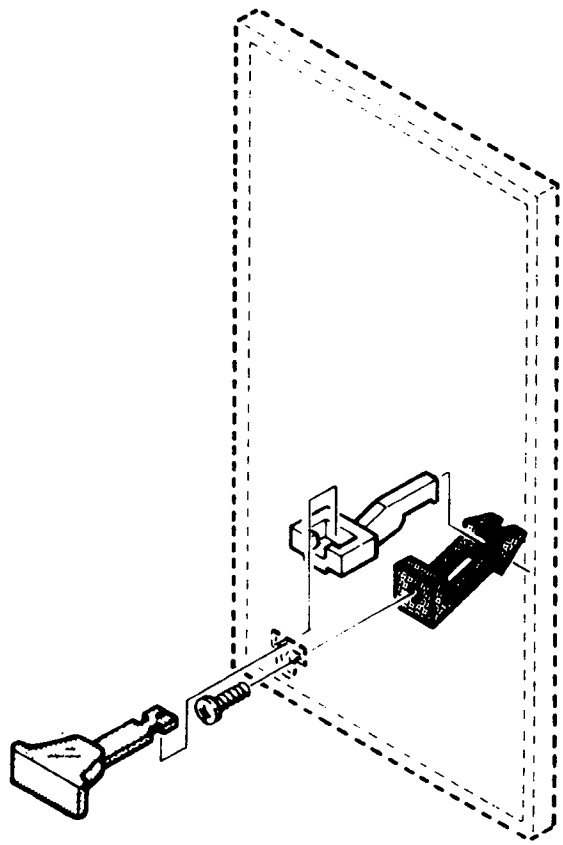


FIG. 1 PLUG-IN LATCH

Latch assembly detail

INDEX NUMBER	PART NUMBER
1	366-1690-01
2	333-1483-03
3	213-0254-00
4	386-2402-05
5	213-0229-00 (4)
6	200-1273-02
7	105-0718-01
8	105-0719-00
9	426-0724-00
10	213-0146-00
11	Circuit board (Not Included)
12	337-1399-00 (2)
13	214-1061-00
14	426-0725-00