



040-0652-05

BLANK PLUG-IN

For TEKTRONIX® TM500* Series Power Modules

All Serial Numbers

This modification kit contains mechanical parts to construct a blank PLUG-IN for use in any TM500 Series Power Module.

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

Even though the TM500 Series of blank plug-ins will operate in the new TM5000 Series Power Modules, no provision is made to connect any circuitry in the blank plug-ins to the GPIB bus.

If your TM5000 system requires customized circuitry, it is recommended that you use a 50M70 Programmable Development card in an MI5010 Multifunction Interface. Approximately 20 square inches of usable circuit board is available in the 50M70 Programmable Development Card, for customized circuitry.

*See notes on pages 2 and 7.

PARTS INCLUDED IN MODIFICATION KIT:

Quantity	Part Number	Description
1 ea	105-0718-01	Release bar
1 ea	105-0719-00	Retaining Latch
1 ea	200-1273-02	Subpanel, back
2 ea	210-1270-00*	Washer, flat, 0.141 ID x 0.04
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
1 ea	386-2402-05	Subpanel, front
2 ea	386-3657-01*	Support, plug-in
1 ea	388-3490-01	Circuit board, Main
1 ea	426-0724-00	Frame section, bottom
1 ea	426-0725-00	Frame section, top

TM500 BLANK PLUG-IN CUSTOM CIRCUITRY

Application of the blank plug-in to your custom circuitry requires the design and fabrication of power supply and interface circuitry. Review of the TM500 Series mainframe manual and TM500 Series plug-in will give you 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 Corp.
6. Linear Integrated Circuits (file 411) (CA 7800) RCA.
7. Linear Integrated Circuit Voltage Regulators, Texas Instrument.

Tektronix will release from time to time applications describing customer built TM500 Series modules. For this and other technical information contact your local Tektronix Field Office.

*Used with TM515 ONLY!

The TM500 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 mainframe allows custom interconnection between modules in a Type TM503, TM504, or TM506 Power Module, or to external devices in all TM500 Series Option 2 Power Modules via rear panel connectors.

Several major power supply components are located in the mainframe:

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. Raw DC (rectified and filtered only) suitable for regulation to plus and minus 20 volts (or less). The common for these supplies is tied to chassis ground in the mainframe.
 - c. Raw DC (rectified and filtered only) suitable for regulation to +5V. The common of this supply is referenced to chassis ground in the mainframe via a 1.0k Ω resistor. The common should be returned to the plug-in chassis by a low resistance path.
 - d. 17.5 VAC derived from the same windings used for c above. This AC voltage is supplied for the purpose of generating -5V in the plug-in if a negative supply is preferred. The common for this supply is the same as for c above.

NOTE

Each supply has a maximum current rating, and they are interdependent. For details, refer to "supply rating summary" on pages 5 and 6.

4. 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. These devices, and their heat-sinks are in the mainframe allowing more heat to be generated by other circuits in the plug-in.

The above power supply circuits provide a sort of "power supply kit" which can be assembled and modified within the plug-in circuits, into a variety of configurations. Regulating devices or circuits (other than series-pass) must be located in the plug-in. In some cases, alternative or supplementary pass devices may be used 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.

NOTE

It is important to know that not all power sources may be used to their full capacity simultaneously. Refer to the "Supply Rating Summary" for details.

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 in mainframe.
2. Plug-in modules.
3. External loads.

External loads are obviously the easiest to handle, since the heat generated is external to the mainframe 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 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 mainframe series-pass dissipation should be held to 7.5 watts. This value may be exceeded temporarily. It may also be exceeded if the instrument is cooled with forced air or is not used in an ambient above 25 deg. C. It is also feasible to exceed this value for one transistor if the other two on the common sink (in the TM503) have proportionally less dissipation. The TM503 heat sinks have thermal cutouts which will protect the pass devices if a long-term thermal overload should occur. The sinking in the TM501 is adequate under all normal conditions of use and no thermal cutout is installed.

The interior temperature of a plug-in will rise about 3 deg. C/Watt at an input power of 6 watts, evenly distributed. At the 12 watt level, the rise is about 2.5 deg. C/W. The actual temperature, of course, depends on the temperature of the air surrounding the mainframe, 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 cross talk considerations.

POWER SUPPLY RATING SUMMARY

Unregulated supply voltages in the mainframe will vary in direct proportion to line voltage. Each supply voltage will decrease appreciably as it is loaded to full current capacity. Each supply voltage will vary slightly as other supplies experience an increase or decrease in load current.

MAIN SUPPLIES

Floating Windings

25 VAC nominal at nominal line voltage, unloaded.
Two per plug-in.

+33.5 VDC

+33.5 VDC nominal at nominal line voltage, unloaded. The output of the 33.5 VDC supply may vary from 24VDC with low line voltage and high current load to 38VDC with high line voltage and low current load. Supplied by common buss to all plug-ins.

350mA max per plug-in. Caution--see "combined load factor" below.

Combined Load Factor

The floating windings and the raw DC supplies basically are alternative ways of obtaining power (other than 5 VDC logic). Although both sources may be used, they should not be used to full rating simultaneously. The pair of floating windings may be used to full capacity, or the DC supplies may be used to full capacity. Whatever percent capacity is unused in one source may be applied to the other sources.

Calculate percent current capacity used by the floating windings. (100 pct if both are supplying 500mA.) Calculate percent current capacity used by the +DC supplies. (100 pct if both are supplying 350mA to the plug-in.) Add the two percentages; total should not exceed 100 pct. The combined percentage is referred to as the "combined load factor".

LOGIC SUPPLIES

+11.5 VDC

+11.5 VDC nominal at nominal line voltage, unloaded. The output of the 11.5 VDC supply may vary from 8 VDC with low line voltage and high current load to 15 VDC with high line voltage and low current load. Supplied by common buss to all plug-ins.

1.0 A max per plug-in if the combined load factor for the main supplied is 100 pct. May be increased linearly to 1.3 A as the main supply combined load factor decreases to 20 pct.

17.5 VAC

17.5 VAC nominal at nominal line voltage, with no load on this or 11.5 VDC supply. The output of the 17.5 VAC supply may vary from 16 VAC with low line voltage and high current load to 23 VAC with high line voltage and low current load. (Voltage is measured between pins 5A and 5B.) May be converted to negative DC by a pair of diodes with their cathodes connected to 5A and 5B; anodes connect to load, and load returns to supply common (3A, 4A, 3B or 4B) and to plug-in chassis.

This supply has the same current rating as the +11.5 VDC. However, any current used by this supply must be deducted from the DC supply.

The TM504 and TM506 Power Modules have one compartment, on the extreme right, which has extra power capability. The following capabilities and limitations must be taken into account when using the high-power compartment:

1. There is nothing in the compartment which forces high power; all units designed for operation in standard compartments will operate normally in the high power compartment.
2. The extra power capacity is limited to the following:
 - a. The power rating of the mainframe series-pass power transistors. The power dissipation for the two mainframe series-pass power transistors can not exceed 50 watts; each individual transistor can dissipate up to 30 watts, provided the other transistor is limited to 20 watts; NPN similar to 2N3055*, PNP similar to Motorola MJ2955.
 - b. The extra current capacity of the two floating ac windings (25V rms nominal). These windings are rated at 1A maximum compared to 500mA in the standard compartments.
 - c. The extra current capacity of the +11.5 VDC and 17.5 VAC logic supplies. These supplies are rated at 4A compared to 1A in the standard compartment.

In addition, these supplies are floating. They may operate floating, or with either the plus or minus terminal grounded.

NOTE

The 4A rating is the total current capacity of both supplies; it may be shared in any desired ratio.

3. Precautions to be observed:
 - a. The +33.5 VDC supply rating and conditions are the same as for the standard compartment. The output of the 33.5 VDC supply may vary from 24 VDC with low line voltage and high current load to 38 VDC with high line voltage and low current load.

*2N6258 in earlier instruments.

- b. Nothing in the supply capability affects the ability of the plug-in module to dissipate heat; temperature rating of the plug-in and the general rules for thermal management still apply.
- c. 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 mainframe. A suitable switch is 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 mainframe shield, in the low-power compartments, leaves the switch in the extended position. Inserting the plug-in in the high-power compartment should actuate the switch.

- d. If the Blank plug-in is to be used in a TM515 Traveler Mainframe, add a support pin, pn 386-3657-00, and a flat washer, pn 210-1270-00, to the holes in the back end of the lower frame rail.

Note: CLEANING INSTRUCTIONS:

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, dry brush, cotton-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.

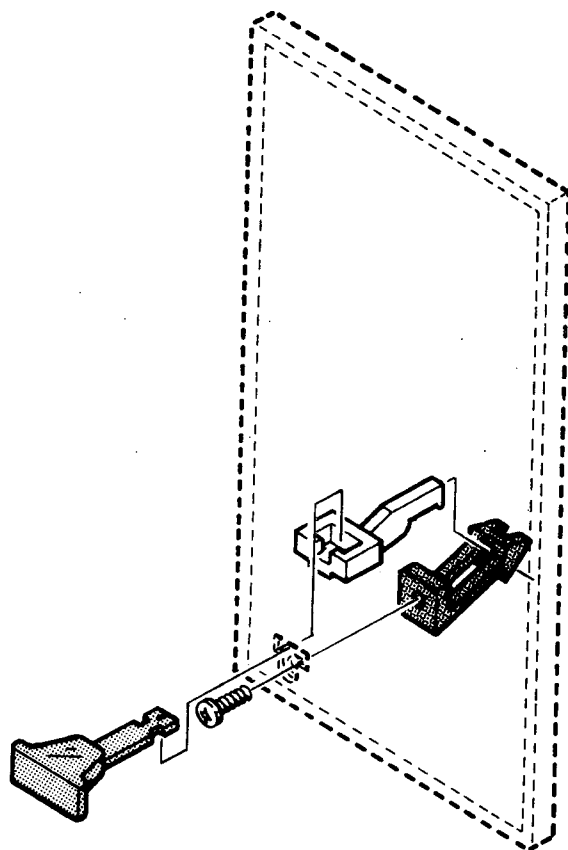


Fig. 1. PLUG-IN LATCH
Latch assembly detail

ASSEMBLY HINTS FOR SINGLE-WIDE PLUG-INS

PART I. ELECTRICAL CONSIDERATIONS

- A. Ease of assembly (or disassembly) will be greatly enhanced if all connections between either the front panel and circuit boards or connections between circuit boards are made using the following considerations.
1. Connections for wires from the front panel are made to the circuit board(s) with multi-wire connectors.
 2. Connections between circuit boards use multi-wire connectors on at least one end.
 3. To facilitate the installation of the 0.025 square pins in the circuit boards, a row of 14 pins mounted in plastic, pn 131-1939-00, is available. The pin carrier strips are notched to snap apart in any number of pins desired.
 4. Use cable connector, pn 131-0707-00, with the above listed square pins. The connectors can be used alone or with ribbon cable and harmonica connectors.

5. Use ribbon cable with four conductor through ten conductors whose part numbers are 175-0827-00 through 175-0833-00, respectively.
6. Use harmonica connectors for four conductor through ten conductor cables, pn 352-0162-XX through pn 352-0168-XX, respectively.

The color of the harmonica connector is indicated by the last two digits in the part number using the resistor color code, i.e., an -02 harmonica is red, etc.

- B. Ease of assembly will be greatly enhanced if you breadboard and fully test the custom circuitry* you are going to build into the blank plug-in and assemble as follows:
1. Make a mock-up of the front panel or make sufficient measurements to assure symmetry and proper spacing for controls and connectors.
 2. Carefully align the front panel, sub-panel and shield after marking the locations of all holes to be drilled in the front panel. BE SURE THAT THE RECTANGULAR HOLES IN THE FRONT PANEL, SUB-PANEL AND SHIELD ARE ALL IN THE LOWER LEFT CORNER (Plug-In Latch).
 3. Drill all holes, debur as necessary, and temporarily mount all components and connectors on the front panel and wire all connections except the front panel connectors. DO NOT INSTALL KNOBS.
 4. Wire all of the circuitry on the circuit board(s) including inter-connect pins and wires.
 5. See Step 3c on page 7 of 10.

PART II. MECHANICAL CONSIDERATIONS

- A. Mechanical assembly will be simplified if the steps are performed in the following order:
1. See note on page 7 of 10.
 2. To facilitate assembly, be sure to use a POZIDRIVE** screwdriver as follows:
 - a. Use a #2 pozidrive screwdriver when installing the circuit board and the front sub-panel with shield and rear panel.

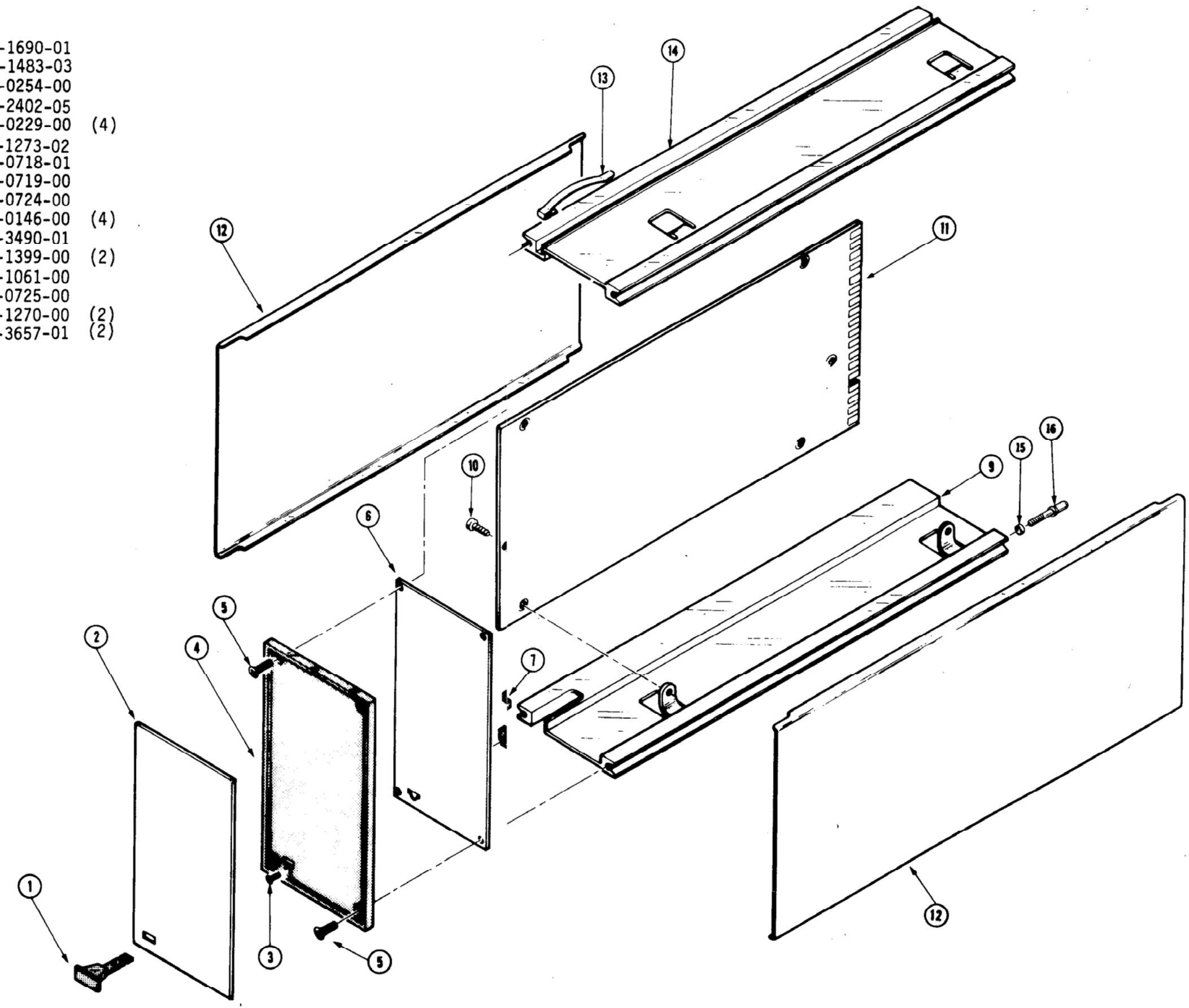
* See note on page 7 of 10.

**Do not use Phillips-type screwdriver.

3. Fasten the two frame rails to the longest circuit board, with pin 1 at the bottom, as shown in the assembly drawing.
 - a. The upper frame rail (#14) has a bump in the slot that goes toward the front panel.
 - b. The copyright and part number information on the circuit board faces outward and should be near the front panel.
 - c. Install the ground clip in the slot at the front of the top frame rail.
4. Fasten the front sub-panel and shield (after removing control mounting hardware and front panel) to the frame rails using the 100° countersink screws. TIGHTEN ALL SCREWS.
5. Install plug-in latch #7 and #8 in the slot, in the lower left frame rail, with the 2-32 x 0.25 inch flat head screw.
6. Reinstall the front panel, control mounting hardware, and input connectors.
7. Install front panel knobs.

JT:ct

- 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 (4)
- 11. 388-3490-01
- 12. 337-1399-00 (2)
- 13. 214-1061-00
- 14. 426-0725-00
- 15. 210-1270-00 (2)
- 16. 386-3657-01 (2)



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