



Model T750

4-Channel High-Voltage Pulse Driver



Technical Manual

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1 Introduction

This is the technical manual for the Highland Model T750 High Voltage Driver.

Features of the T750 include:

- Four transformer-isolated channels
- Adjustable pulse amplitude from 5 to 100 volts into 50 Ω
- Outputs clean, flat pulses with typical risetime 3 nanoseconds
- Standard 12-volt DC power supply
- Ideal accessory for P400/P500 and T560/T660 Digital Delay/Pulse Generators, and the T340, T344, and T346 waveform generators
- OEM packaged or board-only custom available

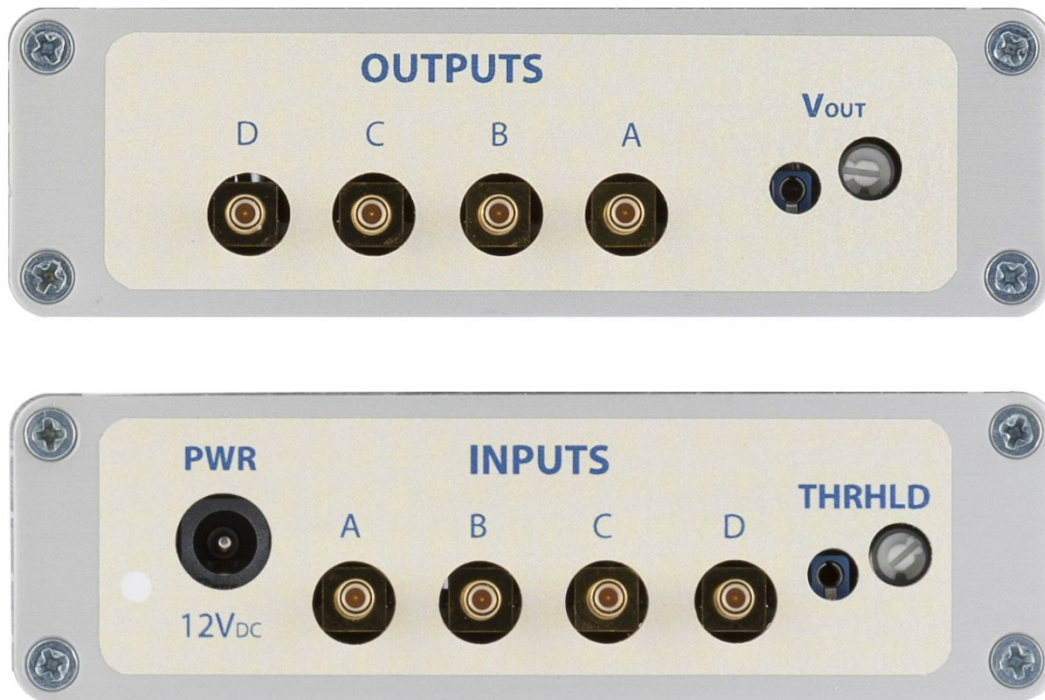


Figure 1. Model T750 High Voltage Pulse Driver (Front and Rear Panel)

2 Specifications

FUNCTION	4-channel, general-purpose, isolated high voltage pulse driver
INPUTS	Four single-ended, positive pulse inputs +5 Volts max 50 Ω terminations +1.0 V minimum usable input Common threshold trimpot, comparator level +0.25 to +2.0 V Threshold-set test point is provided
OUTPUTS	Four individually-isolated transformer-coupled positive pulses Common amplitude adjustment, +5.0 to +100.0 volts into an external 50 Ω load Amplitude set test point is provided Output is inherently low impedance and should be terminated in 50 Ω to maintain proper pulse shapes Max duty cycle 0.2% at 100 volts, 5% at 5 volts Max pulse width 200 ns at 100 volts, 825 ns at 5 volts Min pulse width 8 ns
RISETIME	4 ns max, 3 ns typ.
FALLTIME	See manual section 4.5
JITTER	Less than 25 ps RMS
INSERTION DELAY	8 ns nominal
OPERATING TEMPERATURE	0 to 60°C

CALIBRATION INTERVAL	One year
POWER	+12 volts, 0.8 amps max Highland J12 wall-plug is supplied
CONNECTORS	Signals: SMB Power, 2.5 mm coaxial, center positive Tip jacks monitor for high voltage output level Tip jacks monitor trigger threshold level
INDICATORS	Green power on LED
PACKAGING	4.75" (L) x 4.05" (W) x 1.25" (H)

3 Overview

The T750 is a compact 4-channel high-voltage pulse driver. Each channel includes an input comparator and a transformer-coupled high-voltage power output stage.

Outputs are transformer isolated. A single trimpot, with test point, sets the output levels from 5 volts to 100 volts peak.

Electrical outputs directly follow inputs.

The equivalent schematic of one channel is shown below.

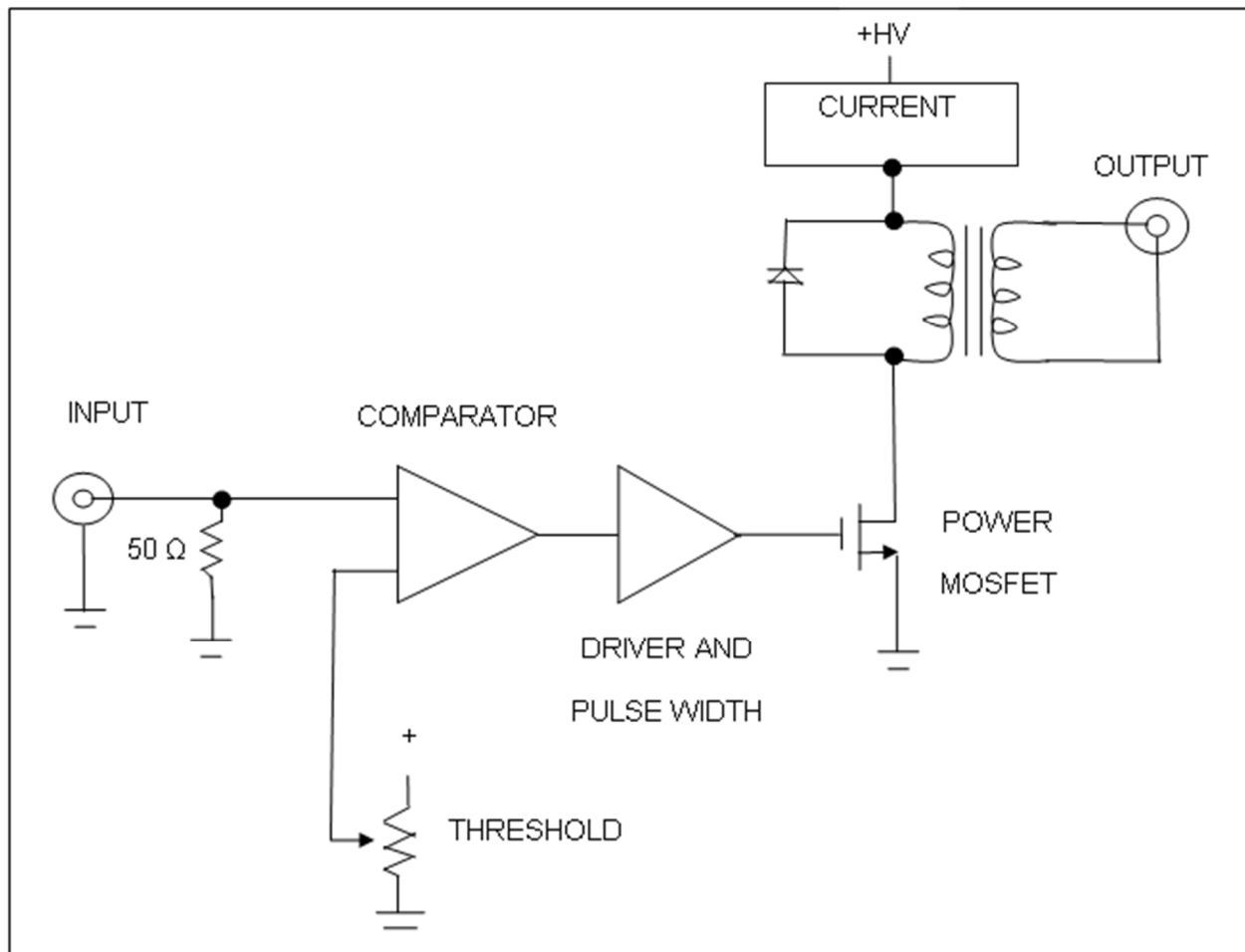


Figure 2. T750 equivalent schematic of one channel.

4 Setup and Operation



CAUTION: The outputs must always be terminated into 50 Ohm loads. Operation without termination can damage the output circuitry.

4.1 Power

The T750 requires an external source of +12V DC power. The power connector on the unit is a female coaxial-type 2.1 x 5.5 mm connector with positive center. The Highland Model J12 power supply is provided.

The T750 enclosure is ground and circuit common. The T750 is protected against polarity reversal and reasonable overloads.

4.2 Threshold Adjustment

The “THRSHLD” trimpot sets the input comparator decision level for all the channels. A test point is provided to assist in accurately setting the threshold level. The T750 outputs go high when incoming signal exceeds the thresholds setting. The test point voltage is scaled 1:1 volts and may be measured with a DVM using the cover screws or the “INPUTS” connector’s shells as ground.

The threshold is factory-set to +1.5 V and is adjustable from 0.25 V to at least 2.0 V. A setting of 40 percent of expected signal pulse is recommended. Setting the threshold too high or too low can result in excess jitter or unreliable operation.

4.3 Inputs

The T750 outputs directly follow the input signals; outputs go high when incoming signal exceeds the thresholds setting (See Section 4.2 for a detailed explanation of threshold settings.) The pulse width and duty cycle limitations of the output pulse should be considered when setting the input signal in order to achieve an optimal output signal (See Section 4.5.1 for details about pulse width and duty cycle limitations).

4.4 Vout Adjustment

The “Vout” trimpot allows the user to adjust the output pulse amplitude from +5V to +100V for all “OUTPUTS” simultaneously. The “Vout” may be measured with a high-impedance DVM using the test point as positive and cover screws or the “INPUTS” connector’s shells as ground. The test point voltage is scaled to +1 volt per 10 volt output pulse amplitude with 15% accuracy to the pulse amplitude.

The “Vout” is factory-set to + 2 V, equivalent to +20 V output pulse amplitude.

4.5 Outputs



CAUTION: Do not connect easily-damaged loads to the high-voltage outputs without suitable protection, such as shunt zener diodes or equivalent.

Each of the T750’s output pulse connectors has an independent input which is dependent on the threshold adjustment (See Section 4.2 for details). All output amplitudes are adjustable from +5V to +100V by using the common “Vout” trimpot (See Section 4.4 for details). The outputs are positive pulses, but may be inverted by external wiring. Cleanest negative pulses can be obtained by adding a coaxial crossover (swapping inner and outer conductors) some distance from either the T750 or the load. If any ringing is observed, slipping a ferrite core or EMI suppressor over the cable near the crossover will usually improve pulse shapes.

The outputs are optimized for high voltage amplitudes.

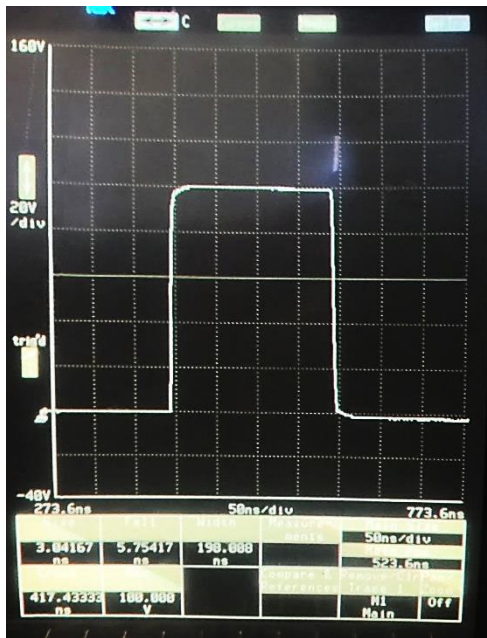


Figure 3

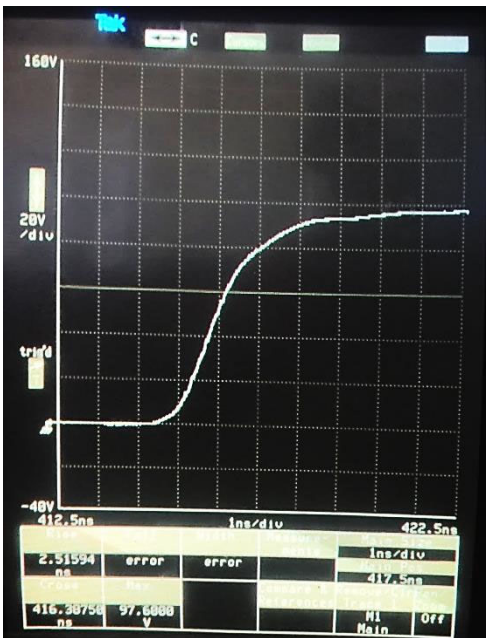


Figure 4

Figure 3 shows a typical 100V, 200ns pulse into a 50 ohm load with the oscilloscope set to 50ns per division. Figure 4 shows the same pulse with the oscilloscope set to 1ns per division.

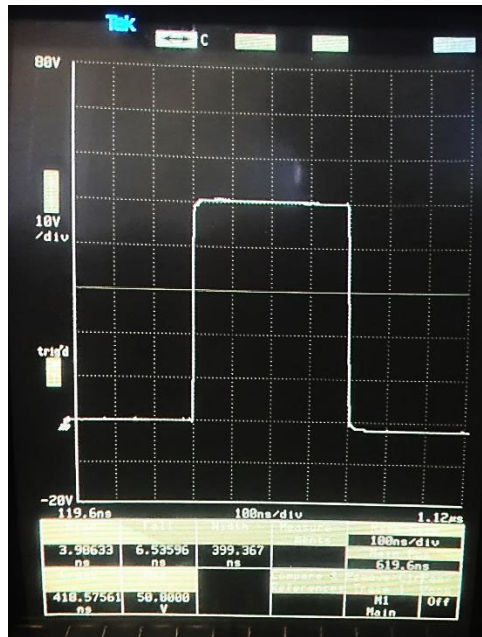


Figure 5

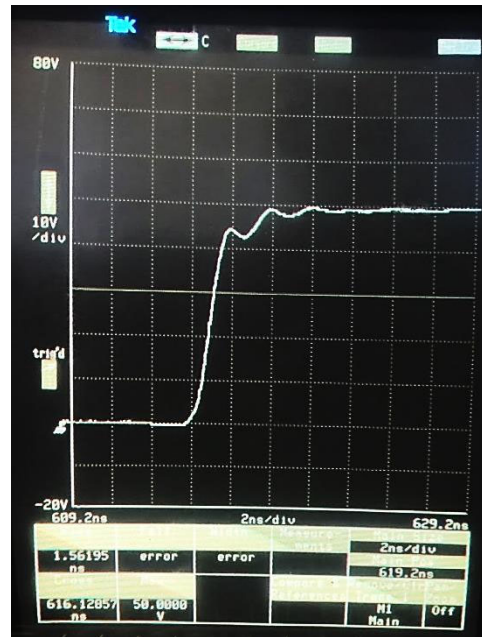


Figure 6

Figure 5 shows a typical 50V, 400ns pulse into a 50 ohm load with the oscilloscope set to 100ns per division. Figure 6 shows the same pulse with the oscilloscope set to 2ns per division.



Figure 7

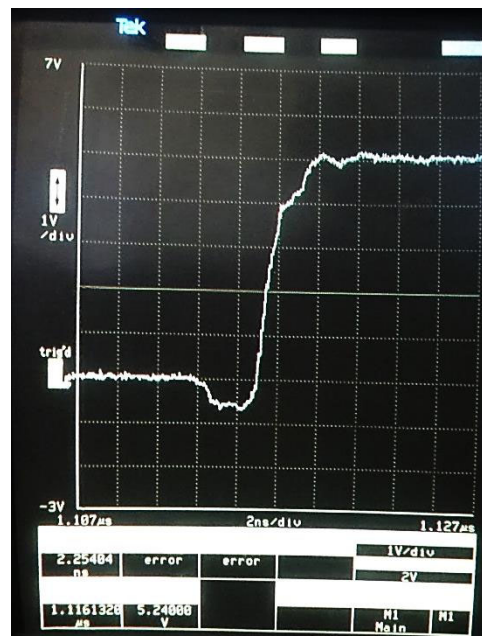


Figure 8

Figure 7 shows a typical 5V, 825ns pulse into a 50 ohm load with the oscilloscope set to 200ns per division. Figure 8 shows the same pulse with the oscilloscope set to 2ns per division.

Figure 9 shows typical rise and fall times at various voltages, again terminated into a 50 ohm load. At higher duty cycles, transformer-circulating current helps the load pull the outputs back to zero, so falltimes will be lower at high duty cycles or rep-rates.

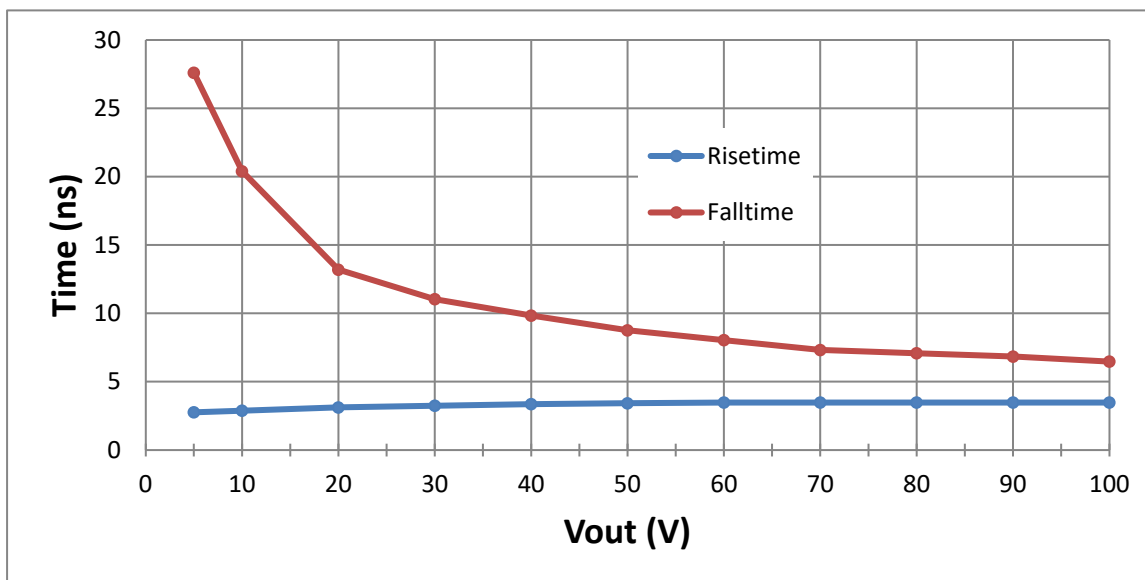


Figure 9. Output rise and fall times

4.5.1 Pulse Width and Duty Cycle Limits

Each output's pulse width directly corresponds to its input signal. Since each output has its own input signal, the output pulse width limits are channel dependent. If the inputs are set above these limits, the driver will limit the output pulse to prevent transformer saturation; however, longer falltimes may result.

In order to optimize falltimes, do not exceed the following pulse widths for a given pulse amplitude:

Output Pulse Amplitude (Volts)	MAXIMUM Pulse Width (ns)
100	225
90	250
80	275
70	300
60	350
50	400
40	450
30	525
20	625
10	750
5	825

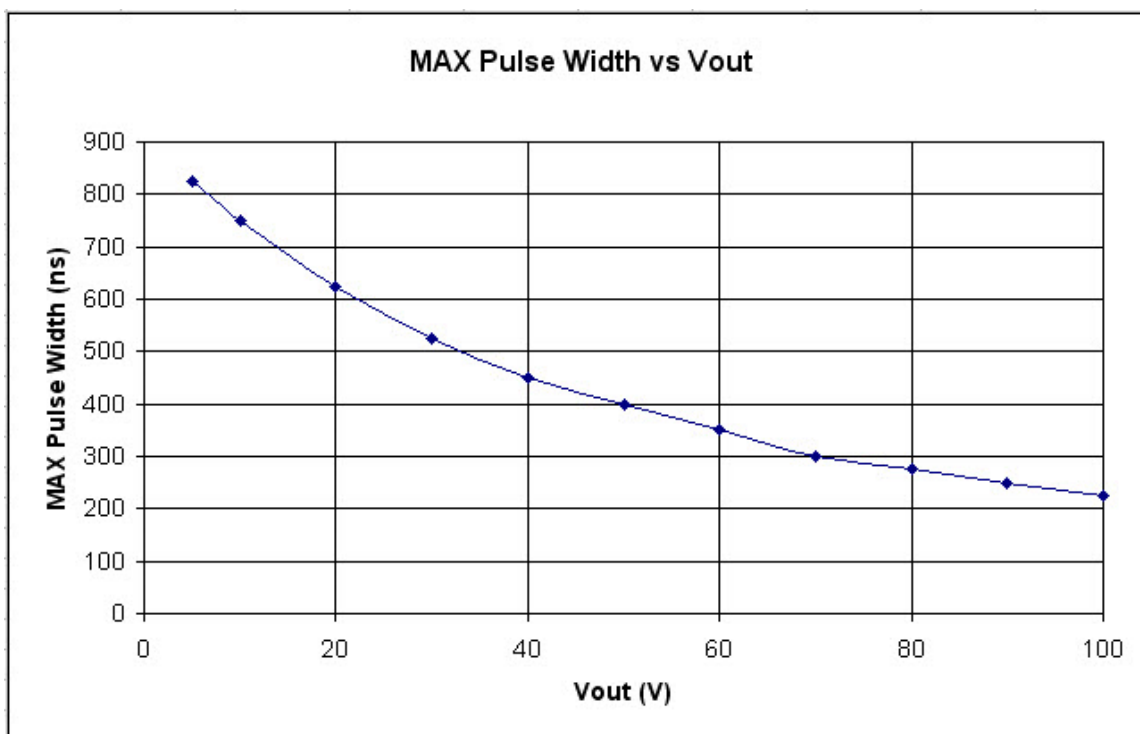


Figure 10. Maximum pulse width as a function of amplitude

The T750 is equipped with a current limiter which will prevent damage to the output FETs caused by power demands beyond the component's limitations. If the input signal has a high rep-rate or duty cycle, the output amplitude will be limited to prevent exceeding the power limitations.

In order to assure that the output amplitude will not be limited, do not exceed the following duty cycles for a given pulse amplitude:

Output Pulse Amplitude (Volts)	MAXIMUM Duty Cycles (%)
100	0.20
90	0.30
80	0.50
70	0.75
60	1.00
50	1.25
40	1.75
30	2.50
20	3.50
10	4.75
5	5.25

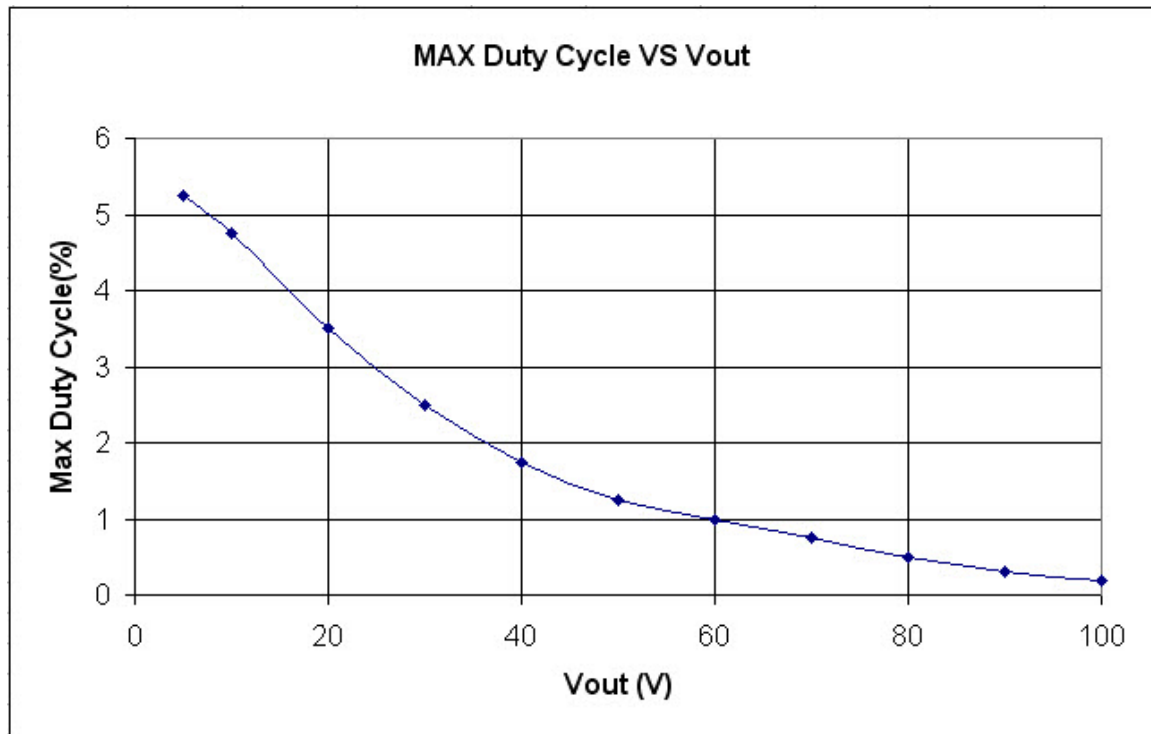


Figure 11. Maximum duty cycle as function of amplitude

5 Dimensions and Mounting

The mechanical dimensions of the T750 are shown below.

The T750 may be mounted with four 4-40 machine screws from below.

If access to the bottom of the mounting surface is inconvenient, an optional T566 flange is available allowing access to mounting screws from above (See Figure 13.)



CAUTION: Mounting screws may not penetrate more than 0.160 inches (4 mm) into the T750 enclosure.

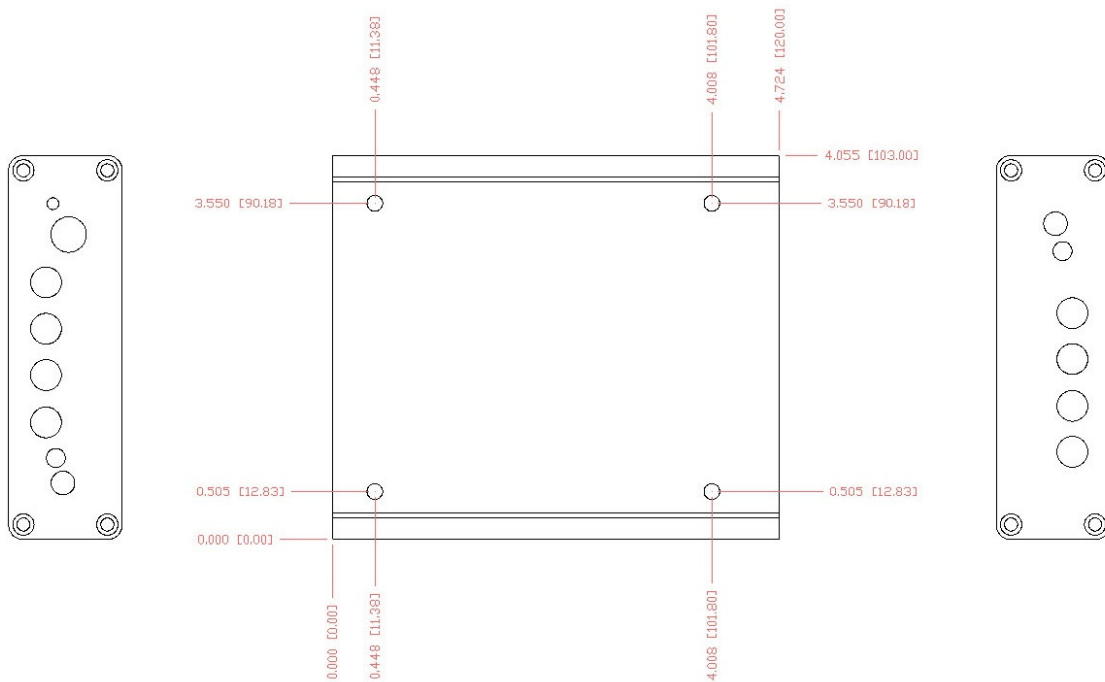


Figure 12. Mounting Dimensions

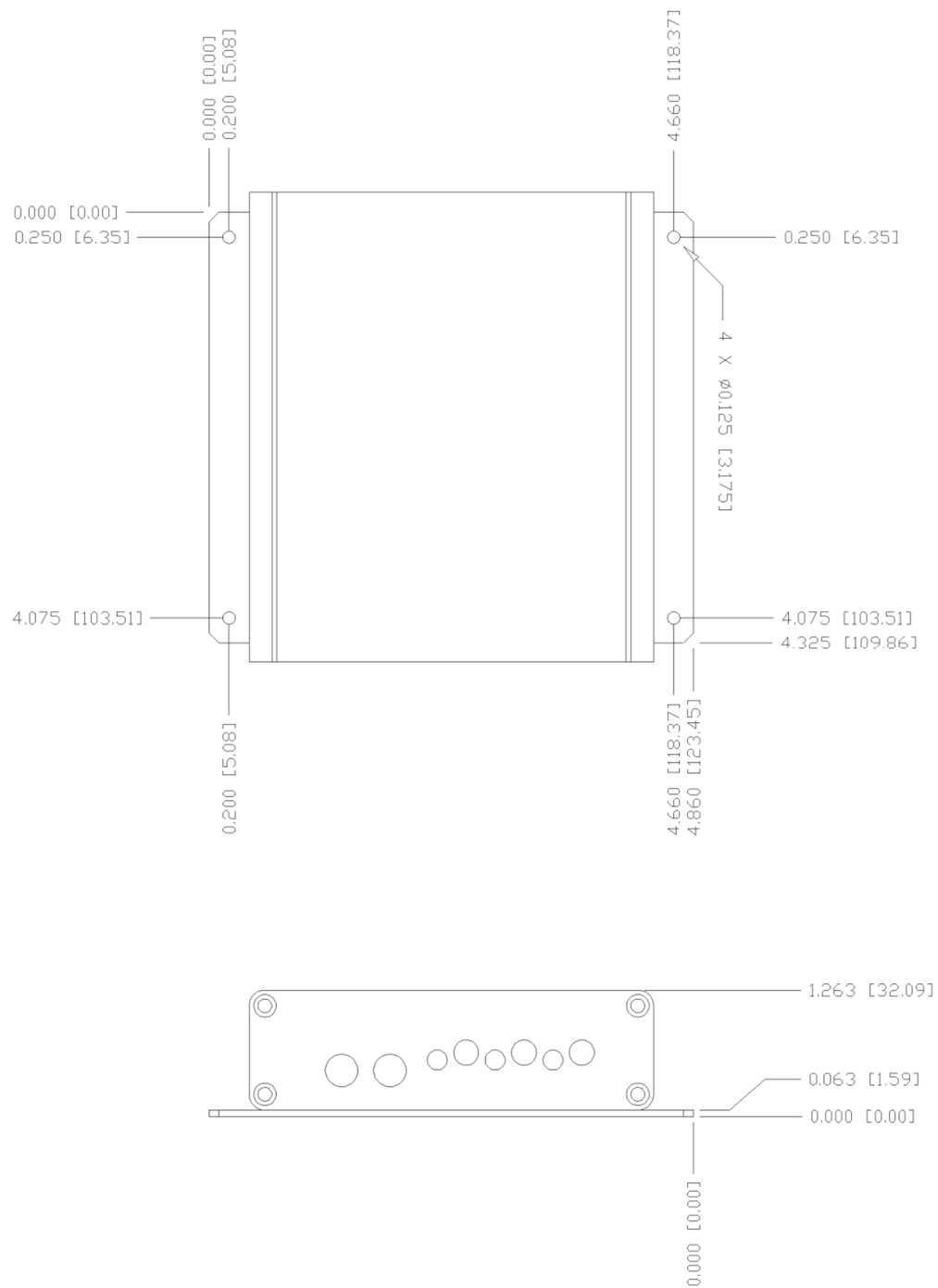


Figure 13. Optional Flange Mounting Dimensions

6 Versions

T750-1: 4-channel 100V pulse driver w/ SMB connectors

Discontinued November 2015

T750-2 4-channel compact 100V driver w/ less than 2.5 nanosecond typical risetime

7 Customization

Consult factory for information about custom versions.

8 Hardware Revision History

Revision C November 2010

Revision B January 2010

Revision A Sept 2009

9 Accessories

J12-1: 12 volt power supply (furnished with purchase)

J50-1: 50 ohm SMB terminator

J53-1: 3' SMB to BNC cable

J53-2: 6" SMB to BNC cable

P10-1: 19" rack mount shelf (four t-boxes per rack)

T566-1: mounting flange