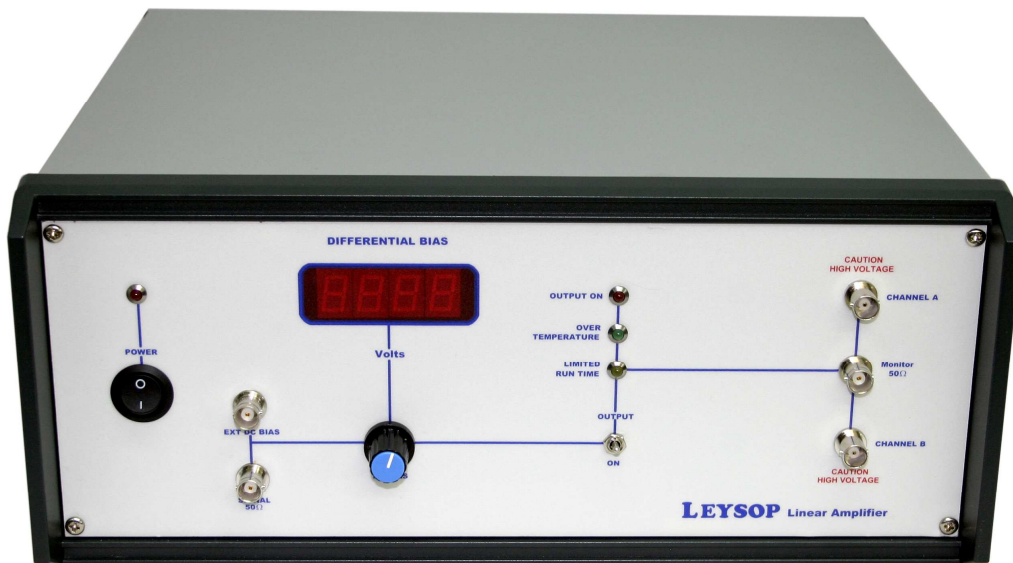


LEYSOP LTD

Manufacturers and suppliers of optical and electro-optical components

Model M500

High Voltage Differential Amplifier



THIS MUST BE READ BEFORE USING THE M500 AMPLIFIER

WARNING

THE MAXIMUM OUTPUT UNDER NORMAL CONDITIONS FROM EITHER A OR B OUTPUT CHANNELS IS 300V. THESE OUTPUTS ARE POTENTIALLY LETHAL AND EXTREME CARE MUST BE USED IN BOTH USE AND SERVICING OF THE AMPLIFIER. IT IS ESSENTIAL THAT THE OPERATING INSTRUCTIONS ARE EXPLICITLY FOLLOWED IN USE, AND SHOULD THERE BE ANY DOUBT ON THE PART OF THE OPERATOR ABOUT THE USE OF THE AMPLIFIER THE MANUFACTURERS SHOULD BE CONSULTED.

The amplifier must not be operated out of its case. Only qualified engineers competent in high voltage engineering should operate or service this equipment

IMPORTANT

The amplifier uses BNC output plugs.

**Take Care not to plug cables from low voltage equipment into the output connectors as this could damage both the amplifier and external equipment
REMEMBER THAT THEY ARE LIVE AND POTENTIALLY LETHAL.**

SPECIFICATIONS

AC POWER INPUT

90 – 264 volts AC
50 – 60Hz

SIGNAL INPUT

Input voltage swing for linear operation ± 4.5 V

Maximum permissible input voltage ± 15 V

OUTPUT VOLTAGES

Normal voltage range for each channel 10 V to 300V

Maximum differential output voltage swing (overdriven) ~ 310 V

Maximum differential output voltage swing without clipping ~ 600 V

Output voltage for zero input signal
and zero differential bias setting 160 V each channel

Output voltages for zero input signal
and maximum differential bias setting one channel 320 V
other channel 25V

Output swing for ± 1.5 volt signal input swing ± 100 V each Channel
about bias value

Effective differential output swing
for ± 1.5 volt input swing 400 V

Gain $\frac{\text{(differential output swing)}}{\text{(input swing)}}$ 133 ($\pm 2\%$)

OUTPUT CURRENT

The amplifier is not designed to provide output current into resistive loads.
Capacitive loads will reduce performance.

NOTE

At full amplitude the amplifier can be operated continuously up to 5 MHz normal room temperatures (up to $\sim 30^{\circ}\text{C}$). Operation At higher temperatures the unit may shut down when the thermal limit is reached. The “Limited Run Time” LED will light to indicate that thermal shut down is possible.

DO NOT BLOCK THE VENTILATION GRILLS ON THE REAR OF THE AMPLIFIER

FREQUENCY RESPONSE

RISE TIME @ Maximum amplitude (500V differential) <70 nS
@ 400V differential or less <60 nS

FALL TIME @ Maximum amplitude (500V differential) <70 nS
@ 400V differential or less <60 nS

RESPONSE -3dB @ Differential amplitude (400V differential) 6 MHz

OUTPUT MONITOR

The monitor output is an accurate representation of the differential voltage at the amplifier output terminals and can be connected to an oscilloscope 50Ω or high impedance input.

Monitor voltage for 500V differential output voltage 1 V into 50Ω load
2V into High Z load

AMPLIFIER FUNCTIONS

Front Panel differential bias setting	Varies differential output over range $\pm 250V$
External DC Bias Input	+/- 5VDC input varies differential output over range +/- 100V
Output ON switch	Turns high voltage outputs on
Output ON indicator	Lights when HV outputs are on
Limited Run Time indicator	Lights when thermal shut down Possible
Over temperature indicator	Lights when thermal shut down has occurred

SWITCHING ON

ALWAYS ENSURE THAT THE VENTILATION GRILLS ARE CLEAR OF OBSTRUCTIONS

Switch on the mains switch and note that the AC Power lamp comes on.

NORMAL OPERATION

For normal operation the controls should be set as follows:-

DIFFERENTIAL	zero
POSITIVE LIMIT	100%
NEGATIVE LIMIT	100%

The signal input to the amplifier is connected to the 'SIGNAL 50Ω' BNC connector. This presents a 50Ω load resistance to the signal source which should be suitable to drive this load. The signal input is DC coupled to the amplifier and any offset voltage present will be reflected in the output signals.

A positive transition from zero on the input will cause the A channel output to rise and the B channel output to reduce and conversely for a negative transition. Channel A output, the net differential output voltage and the monitor output are in phase with the input while Channel B output is 180 degrees out of phase with the input.

DIFFERENTIAL BIAS CONTROL

The 'DC BIAS' control adjusts the mean levels of the A and B output channels.

With the bias control set to zero both A and B channel outputs will be biased to ~150V.

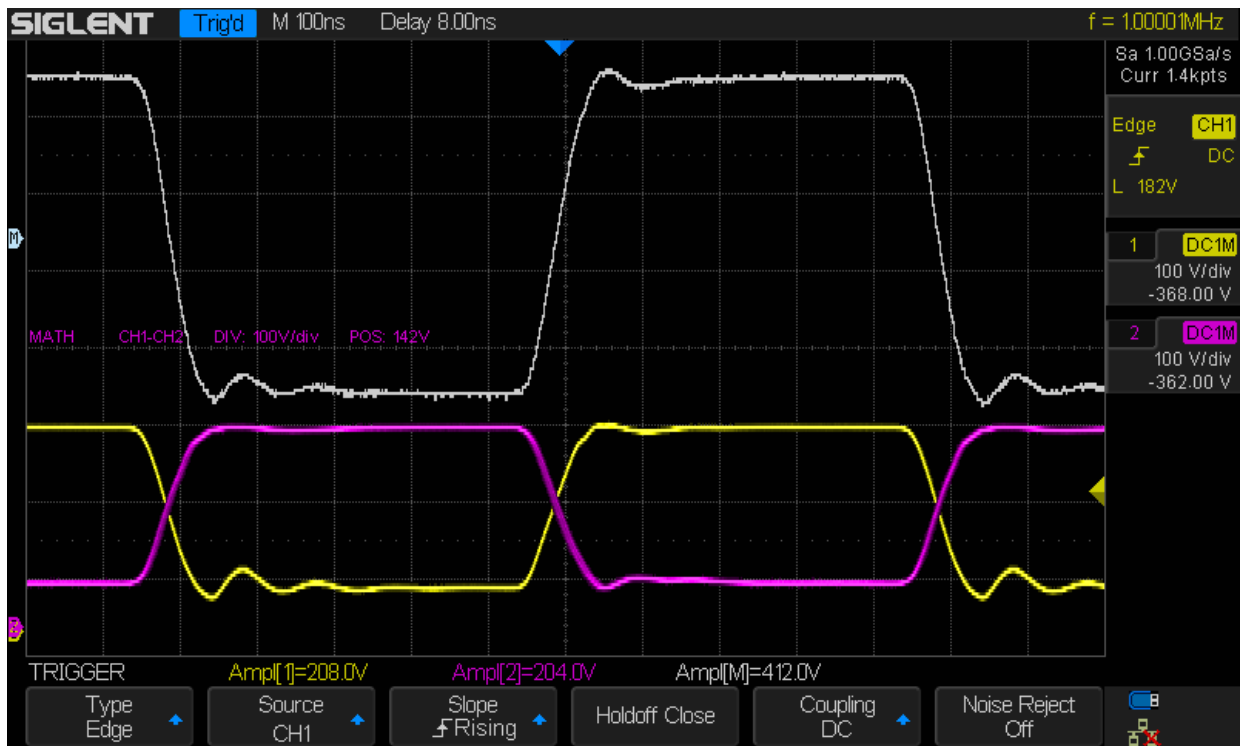
When the 'DC BIAS' control is set to maximum clockwise rotation the A output bias will be ~275V, and the B output bias will be ~25V. Thus the differential output voltage will be $V_A - V_B = \sim +250V$.

When the 'DC BIAS' control is set to maximum anticlockwise rotation the A output bias will be ~25V, and the B output bias will be ~275V. Thus the differential output voltage will be $V_A - V_B = \sim -250V$.

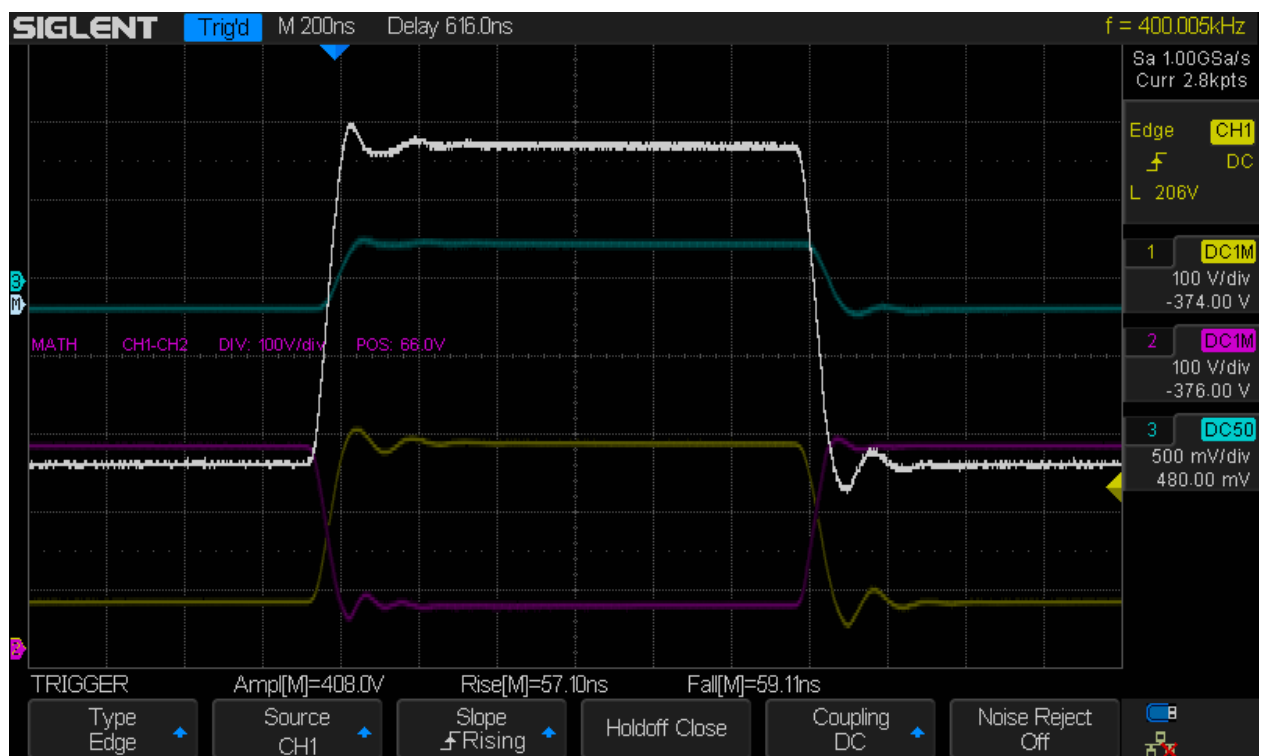
The 'DC BIAS' control allows the output levels to be precisely adjusted across the Pockels cells for 'zero voltage input conditions', thereby achieving the best extinction ratio or lowest residual phase modulation.

Similarly a voltage at the 'EXT DC BIAS' input will alter the output DC bias across the amplifiers dynamic range. An input of +5V produces a bias of +250V and -5V produces a bias of -250V. The 'DC BIAS' control and the 'EXT DC BIAS' can be used together and the net bias will be the sum of the two settings.

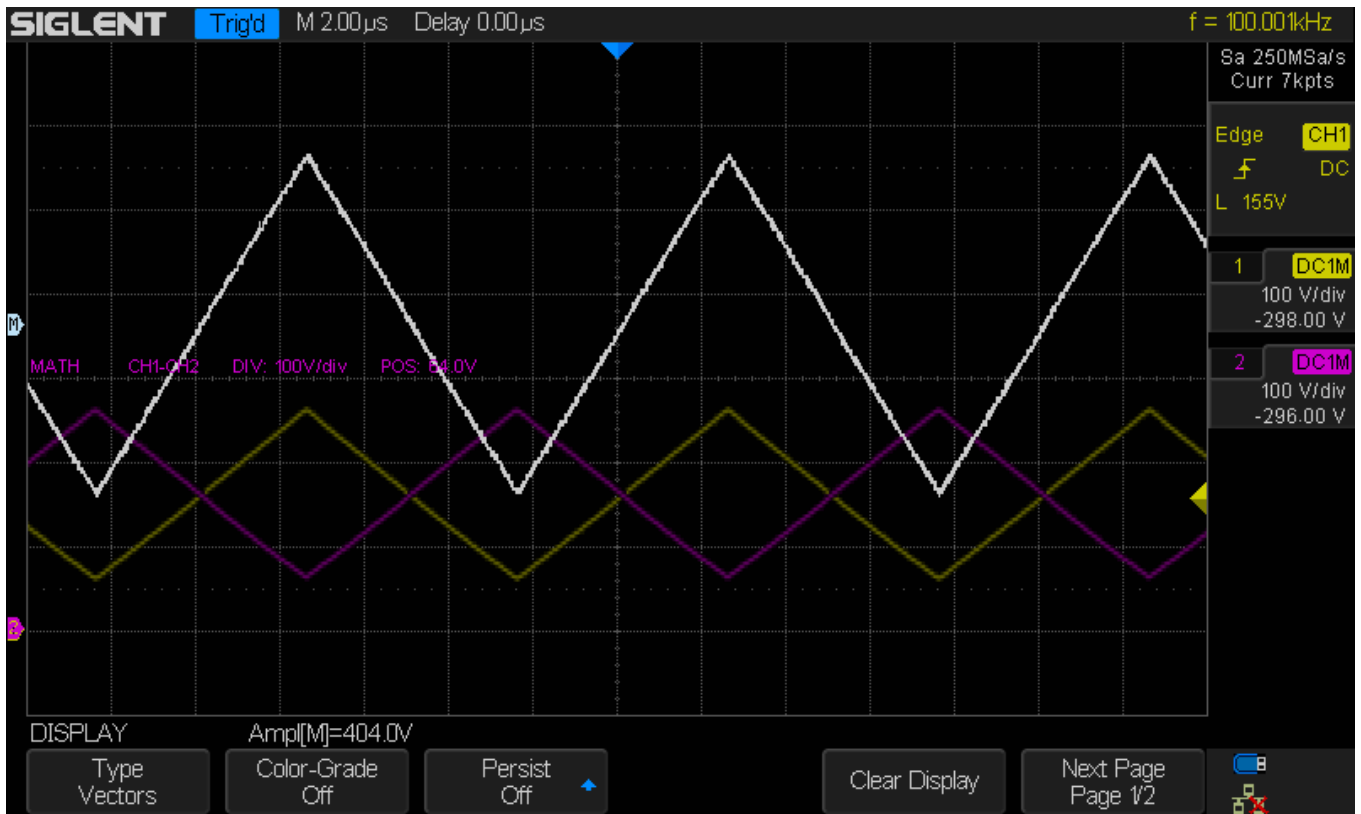
The digital meter will show the actual DC bias voltage at the outputs. (The meter reading will be affected by very low frequency and/or non symmetrical waveforms).



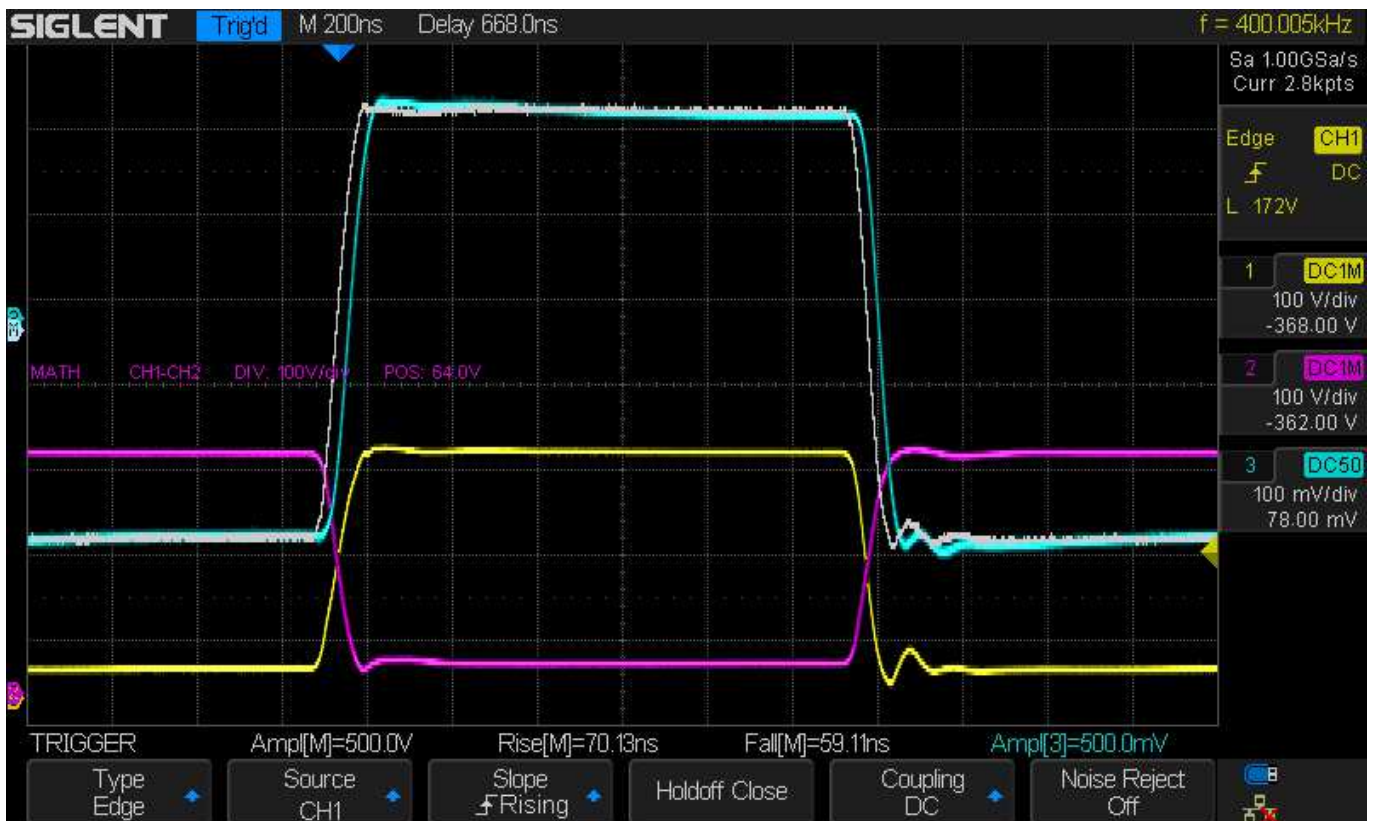
Typical Differential Output Waveform at 1MHz and 400V



Typical rise and fall times at 400V output



Typical Triangular Wave (White=Differential Output at 100kHz and 400V)

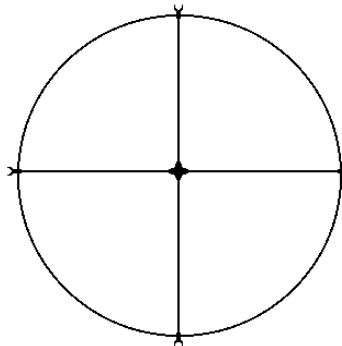


**Typical Monitor Output (Blue) compared with Differential Output (White)
 500 Volts Output**

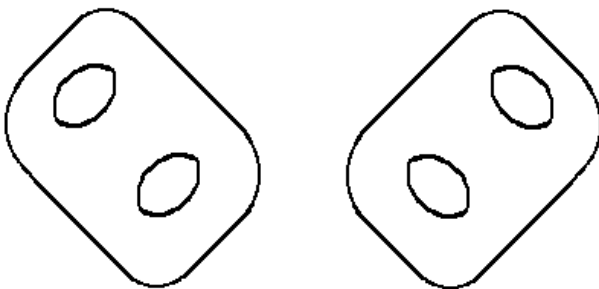
A SIMPLE SETTING UP AND FAMILIARISATION PROCEDURE FOR THE M500 AMPLIFIER AND EM500 SERIES MODULATION

Ensure all connections to the amplifier are made correctly and safely.

1. Connect the modulator to the amplifier using the two leads provided.
2. Connect external oscillator to input with 1Hz square wave and amplitude at min.
3. Set Slew rate switch OFF
4. Set positive and negative Output Limits fully clockwise.
5. Switch Output On and increase the input signal amplitude.
6. Check that the amplifier is working by observing the monitor output using an oscilloscope.
7. Hold the modulator between two squares of polaroid with the axis of the polaroid film lying along the radial axis of the BNC HV sockets and observe a white light source through this combination. With the polaroids crossed a MALTESE fringe pattern should be seen thus.



As the 1Hz square wave amplitude is increased the Maltese Cross will be changed until at full amplitude the cross will switch between right hand and left hand output polarisation states as shown below.



Full +
Output & Sense
Voltage -

There is then a phase shift between the ordinary and extraordinary rays leaving the modulator of $\pm 180^\circ$. Precise square wave \pm phase shifting can be achieved between $0 - 180^\circ$ by adjustment of the limit potentiometers.

7. If one limit potentiometer is set at zero, only one side of the modulator crystal is driven and the output polarisation state will switch in one direction only. This arrangement can be used for amplitude modulation of a laser beam.

SETTING UP THE MODULATOR WITH A LASER BEAM

The input polarisation must be along the BNC axis or at 90° to that axis.

A suitable output polariser should be crossed to the input polarisation state.

Initially set up the modulator with back reflections along the beam axis. Place a fine ground glass screen between the input polariser and the modulator and a Maltese cross should be observed after the analyser.

Adjust the modulator position until this cross is central to the beam axis. The best extinction ratio is then achieved. This must be performed with the EHT switched OFF.

Issue 1.0 7th October 2020