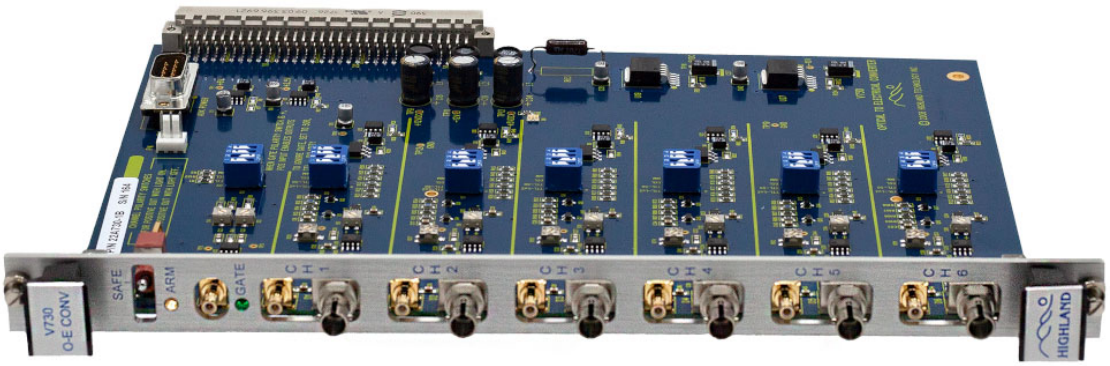
HIGHLAND TECHNOLOGY

V730
6-CHANNEL VME OPTICAL-TO-ELECTRICAL CONVERTER



Technical Manual

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1. Introduction

The V730 is a six-channel optical to logic-level electrical converter. It is useful for sending fast digital signals over extended distances, exploiting the advantages of fiber-optic cable: low attenuation over distance, wide bandwidth, and freedom from ground loops and EMI.

Features of the V730 include:

- Six channels of logic-level optical-to-electrical conversion
- Accepts optical inputs from Highland e/o converters or compatible sources
- Outputs fast TTL, ECL, or NIM digital levels
- Propagation delay 10 nanoseconds typical
- Link jitter below 12 picoseconds RMS
- FC and ST connectorized versions accept 850 nanometer, 1310 nanometer, or 1550 nanometer optical input
- For use in a VME rack, or standalone with available external power supply
- Compatible with Highland optical transmitter products:
    - V720 Electrical/Optical Converter VME Module
    - J720 Electrical/Optical Converter
    - J724 Electrical/Optical Converter
    - V880 System Timing Module

ESD WARNING

THE HIGH-SPEED SEMICONDUCTORS USED IN THE V730 ARE SUBJECT TO DAMAGE BY ELECTROSTATIC DISCHARGE. OBSERVE STANDARD STATIC PROTECTION PROCEDURES IN HANDLING AND USING THIS PRODUCT.

2. Specifications

FUNCTION	Six channels of logic-level optical-to-electrical conversion
INPUTS	Six Si PIN detectors (850 nm version), ST connectors, suitable for use with 62/125 µm multimode fiber 1310 nm and 1550 nm versions utilize ST or FC connectors and InGaAs PIN detectors, suitable for use with 9/125 µm singlemode fiber Optical threshold adjustable 100 to 1250 µW, factory set to 250 µW
PROPAGATION DELAY	Single channel light in to electrical out: 10 ns, typical V720 + V730: 11.4 ns, typical (plus fiber delay)
OUTPUTS	Six logic levels on SMB connectors, individually selectable as TTL/LoZ, TTL/50 Ω, ECL, or NIM levels; switchable output polarity
BANDWIDTH	DC to 180 MHz repetition rate
RISETIME	Electrical outputs: < 750 ps, 10 to 90%
JITTER	< 12 ps RMS, typical (V720 + V730 combination)
OPERATING TEMPERATURE	0 to 60ºC; extended MIL/COTS ranges available
CALIBRATION INTERVAL	One year
POWER	Standard VME supplies: +5V: 150 mA +12V: 60 mA + logic load current -12V: 450 mA
CONNECTORS	ST or FC optical input receptacles

	Gold plated SMB logic output and GATE jacks D9 male power jack
INDICATORS	LEDS: Amber ARM, green GATE
PACKAGING	6U single-wide VME module The V730 uses only power from the VME bus and passes all grant signals

3. Theory of Operation

The V730 includes six independent logic-level optical-to-electrical converter channels. Each channel includes a silicon (850 nm version) or InGaAs (1310 nm and 1550 nm versions) PIN diode detector, a transconductance amplifier, a comparator, a polarity control circuit, and an output driver.

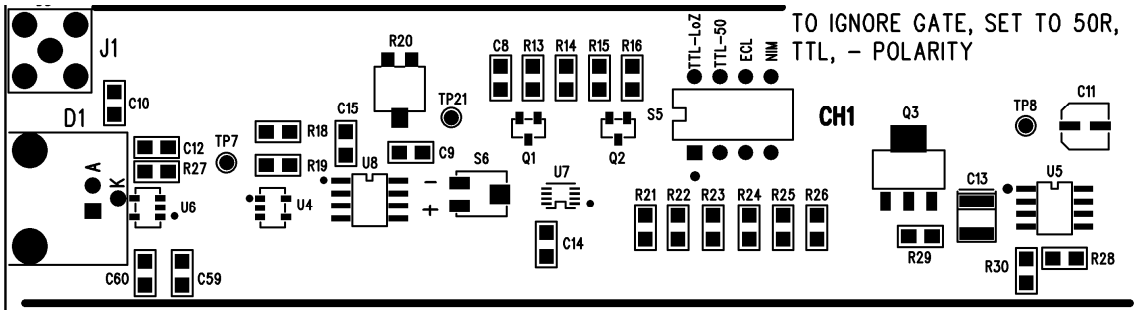

Figure 1 is a depiction of a typical channel (CH1).

The transconductance amplifier outputs a signal of about 2 volts per milliwatt of incident light. A trimpot is provided to set the comparator threshold, with equivalent optical threshold adjustable from about 100 to 1250 microwatts.

The output driver generates a fast 5.5-volt logic swing. A dipswitch is provided to allow selection of one of four logic levels: TTL low impedance, TTL 50 Ω, ECL, and fast NIM.

A gating circuit enables or disables all six electrical outputs. A GATE input connector is provided, and a dipswitch sets the gate threshold level to TTL, ECL, NIM, or zero volts. A polarity switch allows the GATE input to be active high or low, and a green LED illuminates when the channels are enabled.

A toggle switch allows power to be applied to or removed from the output drivers. If the switch is ON, the yellow LED will illuminate and the drivers will be powered up.

4. Installation

4.1 Switch Settings

Before installing the V730 in a VME crate, various on-board switches should be set.

Two kinds of switches are used, DIP and rotary.

Four-position dipswitches are used to select logic levels. To select a level, set only one switch section ON by pressing the side of the switch near the labeled logic level.

Option switches appear similar to single-turn trimpots. To assert a setting, rotate the switch with a small screwdriver so that the slot in the switch points to the marked setting.

4.2 Channel Settings

Each optical-to-electrical channel has one rotary polarity switch, one threshold trimpot, and one logic-level dipswitch.

4.2.1 Output Logic Level Switch

Each of the six o/e channels has a 4-section dipswitch that selects the level of its electrical output. The switch sections are labeled on the circuit board.

Output voltage selections are...

Switch Setting	Source Impedance	Output Volts
TTL-LOZ	15 Ω	0 to +4 V into 50 Ω load
TTL-50	50 Ω	0 to +5.5 V into HiZ load
ECL	50 Ω	-1.9 to +0.8 V into 50 Ω to ground
NIM	HiZ	0 to -0.8 V into 50 Ω to ground

Use TTL-LoZ to drive a cable terminated in 50 Ω to ground. The voltage at the termination will be 0 V (low) and +4 V (high) typical.

Use TTL-50 to drive 50 Ω cables with high-impedance loads at the end, such as CMOS gates. The output will swing from 0 volts to +5.5 volts nominal, and any far-end reflections will be absorbed by the V730 source-terminated driver. If lower logic levels are desired, the drive may be partially terminated to reduce the Vhigh level.

The ECL selection will deliver a low level of about -1.9 V and a high of -0.8 V when terminated at the load with 50 Ω to ground.

The fast NIM level is a constant-current driver, outputting -16 mA as "high" and 0 mA "low". It should be terminated at the load with 50 Ω to ground, producing -0.8 volts "true" and 0 volts "false" at the terminator. The NIM level can also be used as an ECL driver if terminated by 50 Ω to -0.8 volts. NIM is sometimes advantageous because, using current drive, ground-loop jitter is minimized.

4.2.2 Channel Polarity

Each channel has a dedicated polarity switch.

A channel will produce a "high" level output when light is received if its polarity switch is set cw to the "+" position. In the ccw "-" position, the level is high with no light. The NIM output is -16 mA with light when the polarity switch is set "+".

4.2.3 Input Threshold Adjustment

Each o/e channel has a threshold setting trimpot: R20 for CH1, R37 for CH2, R55 for CH3, R74 for CH4, R92 for CH5 and R111 for CH6. The threshold adjustment range is from zero (fully ccw) to 1250 uw (fully cw), nominal, with the actual usable lower level about 100 uw. A good setting is about 25% of the expected optical pulse level, or about 250 uw when used with a 1-milliwatt V720 transmitter.

Two test points are provided on each optical receiver channel. The TP closest to the front panel (TP7, etc.) is the output of the optical receiver transconductance amplifier, scaled approximately 2 volts per milliwatt of received power. A second test point is provided next to each threshold pot (TP21, etc.). The threshold is factory-set to 250 uW optical power, or about 0.5 volts at the threshold test point.

4.3 Gate Input

The GATE input enables all six optical-to-electrical converters. The GATE input has switches to select its logic threshold, polarity, and termination.

To terminate the gate input with 50 Ω to ground, rotate the gate termination switch ccw to its "50R" position; for high-impedance input, rotate it cw to "HI-Z".

Set the gate polarity using the "+-" switch. If this switch is set ccw to the "+" position, a gate voltage more positive than the selected threshold will enable outputs. If rotated cw to the "-" position, a low input will enable the outputs.

The four-section GATE threshold dipswitch sets the gate logic level. Turn one section on, TTL, NIM, ECL or 0 V. Threshold voltage is +1.25 V for TTL, -1.35 V for ECL, and -0.4 V for NIM.

The GATE circuit will enable all outputs if its input is electrically positive (i.e., above the threshold setting) and its polarity switch is "+". In the "-" setting, this sense is reversed, and a low input enables inputs.

4.4 Default Settings

The factory default settings are:

All channel polarity switches cw, "+", active-high outputs when light is received.

All output level dipswitches set to TTL-50R

All channel thresholds set to 250 uW.

GATE threshold TTL

GATE termination ccw, 50 Ω

The GATE polarity is set to "-", which enables all channels with no signal connected to the GATE input connector.

4.5 Output Driver Power Switch

A front-panel switch allows logic driver power to be disabled. If the switch is moved to the left ARM position, outputs are enabled and the yellow ARM LED illuminates; in the right SAFE position, all output power is removed.

4.6 Installation in VME Crate

The V730 may be installed in any slot in a VME crate. It uses only standard VME power supplies, and does not interface to the VME data lines except to pass all bus grant signals.

Turn crate power off before installing or removing the V730. The front-panel hold-down screws must be tight before applying crate power.

4.7 Non-VME Use

The V730 may be used standalone, without a VME crate. Mounting holes are provided for securing the module to a grounded metal surface, and a DB9 male connector is provided on the board for applying DC power.

See Figure 2 for mounting dimensions.

The DB9 connector P2 pinout is:

PIN	FUNCTION
1	GROUND
3	-12 V
4	+12 V
5	+12 V
6	GROUND
7	+5 V
8	+5 V
9	GROUND

The redundant +5 and GROUND pins may be used to reduce cabling voltage drops on long runs. The module mounting holes are connected to GROUND, and

it is recommended that these holes be securely fastened to an earth-grounded metal mounting surface.

The Highland Technology model J192 power supply is available for direct connection to P2. This allows standalone use, or may be used to make on-board adjustments outside of the VME crate.

5. Typical Performance

The following figures are oscilloscope waveforms depicting typical V730 performance. The optical inputs were generated by a Highland model V720 electrical/optical converter module operating at 850 nm, 1 milliwatt nominal power, with electrical input from a Highland model P400 digital pulse/delay generator. The combined observed jitter of the P400 and the Tektronix 11802 sampling oscilloscope is about 6 picoseconds RMS.

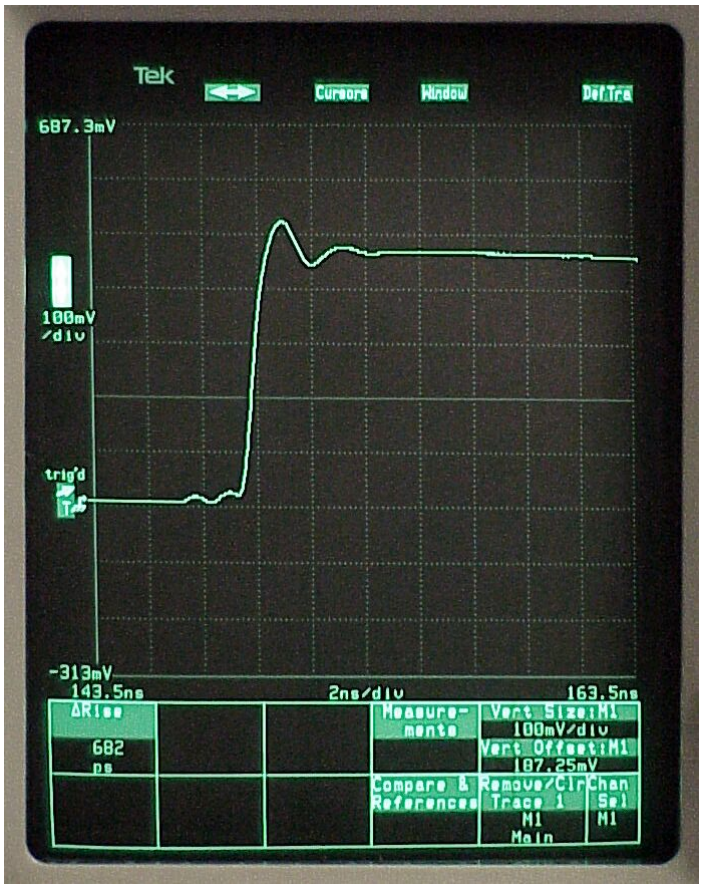

Figure 3. TTL-LoZ pulse into 50 Ω load, 1 volt/cm

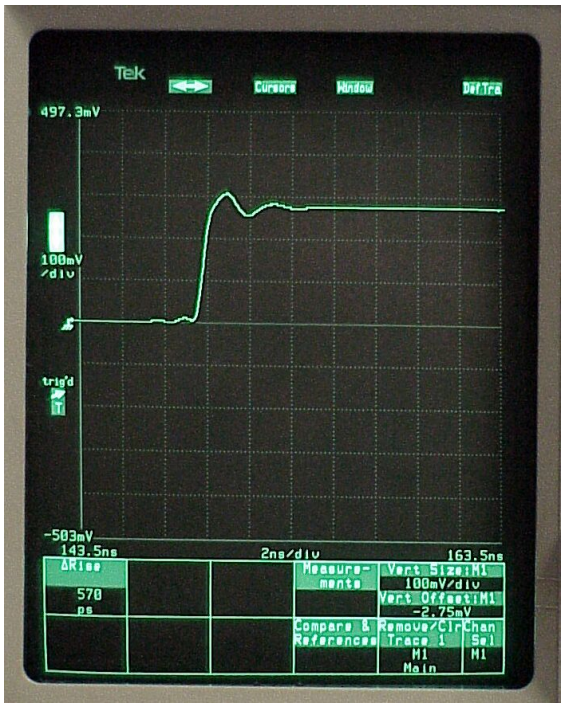

Figure 4. TTL-50R pulse into 50 Ω load, 1 volt/cm

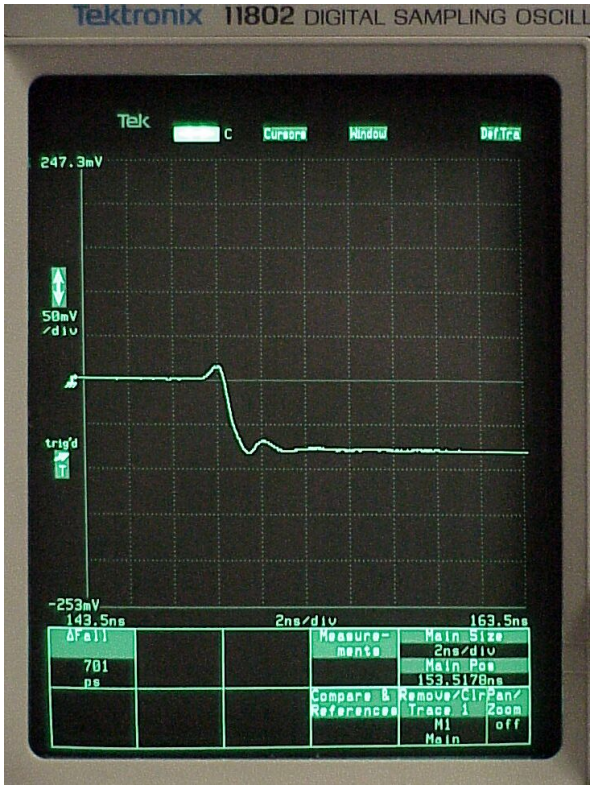

Figure 5. NIM pulse into 50 Ω load, 0.5 volt/cm

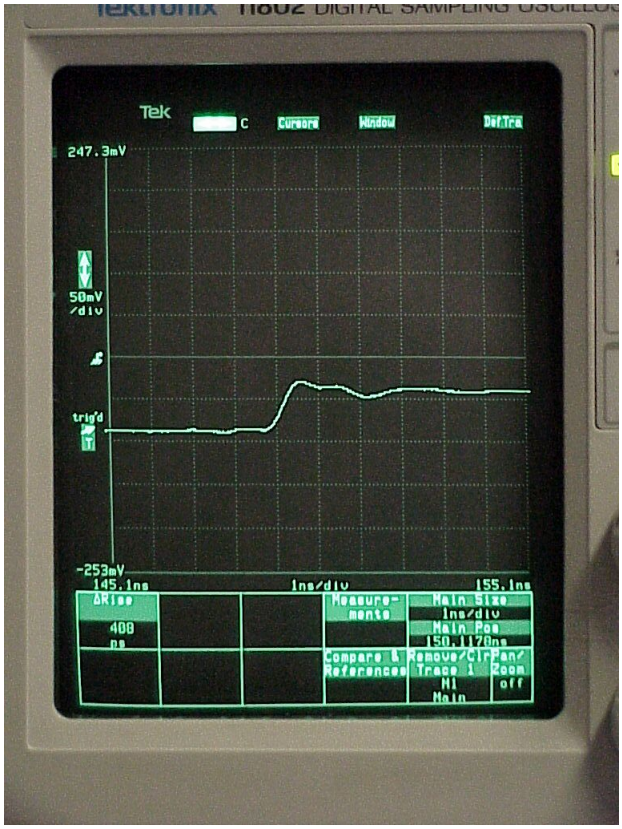

Figure 6. ECL pulse into 50 Ω load, 0.5 volt/cm

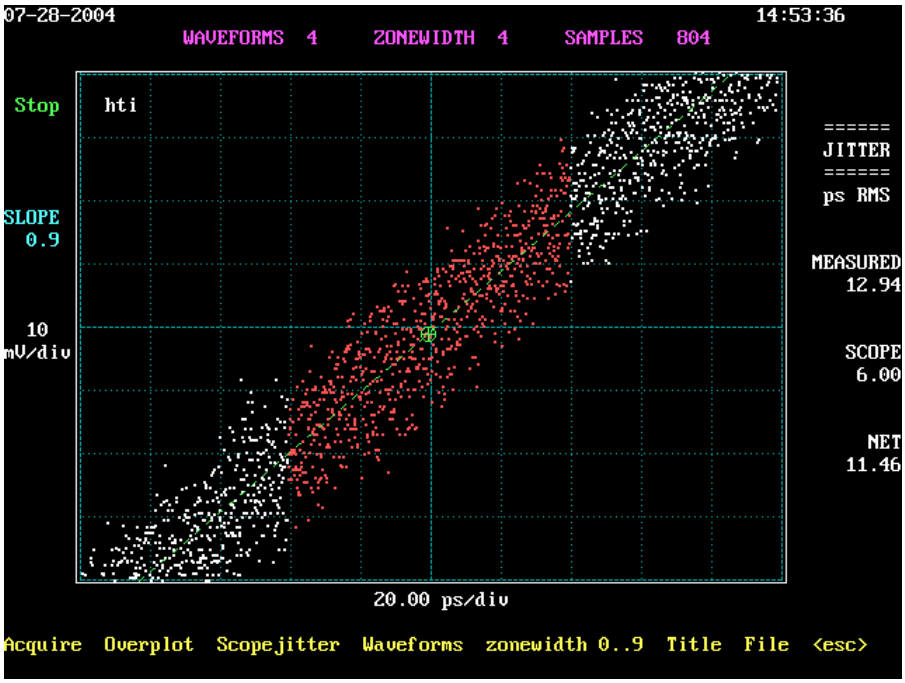

Figure 7. Jitter analysis, V720 + V730 combination

6. Versions

V730-1: 850 nm 6-channel VME optical-to-electrical converter with ST connectorization

V730-3: 1310 nm 6-channel VME optical-to-electrical converter with ST connectorization

V730-5: 1550 nm 6-channel VME optical-to-electrical converter with ST connectorization

V730-11: 850 nm 6-channel VME optical-to-electrical converter with FC connectorization

V730-13: 1310 nm 6-channel VME optical-to-electrical converter with FC connectorization

V730-15: 1550 nm 6-channel VME optical-to-electrical converter with FC connectorization

7. Customization

Consult factory for information about additional custom versions.

8. Hardware Revision History

Revision B	May 2008
Revision A	Mar 2004 Initial PCB release

9. Accessories

J41-1: 3' SMB to SMB cable

J41-2: 6" SMB to SMB cable

J42-1: 3' SMB to SMA cable

J53-1: 3' SMB to BNC cable

J53-2: 6" SMB to BNC cable

J59-1: 3' ST to ST fiberoptic cable (multi mode simplex)

J60-1: 3' FC to FC fiberoptic cable (single mode simplex)

J61-1: 3' ST to ST fiberoptic cable (single mode simplex)

J192-1: stand-alone power supply