The Tellun Corporation

JLH-2090CV Daughterboard for Blacet/Wiard MiniWave

User Guide, Rev. 1.1

Circuit design by Larry Hendry

Scott Juskiw The Tellun Corporation scott@tellun.com	JLH-2090CV User Guide Revision 1.1 August 3, 2004

Introduction

The JLH-2090CV is a daughterboard for the Blacet/Wiard MiniWave. The JLH-2090CV is intended to be used with Dave Hylander's MiniWave ROM Expansion board. The JLH-2090CV adds voltage controlled switching of ROMs on the expansion board and an inverter for providing an inverted output from the MiniWave. The JLH-2090CV also provides space for mounting the MiniWave's four BANK and four WAVE LEDs. An MOTM format panel for the expanded and enhanced MiniWave is available from Stooge Enterprises.

Circuit Description (by Larry Hendry)

The controls on the Miniwave CV expander were fashioned to duplicate the original Miniwave "bank" and "wave" selection controls. Therefore, the ROM SELECT control (VR2) can manually select any of the ROMs without external voltage control. The ROM CV control (VR1) is an attenuator for the incoming ROM CV IN used to select the active ROM. The ROM SELECT control can also be used to bias the ROM selection to mid point for AC control voltages delivered to the ROM CV IN jack. R15 is used to set a minimum so the ROM SELECT control does not attempt to deselect all ROMs causing the voltage limiting circuit to activate. More on that later.

The first op amp (U2A) is ½ of a TL072. It is an inverting summing amp. So, it sums the incoming CV voltage with the internal ROM control voltage (op amps actually sum current, but that's another lesson). The gain of this amp is set at about 1.3x (120K / 93.1K) from the incoming CV so that 5 volts in will produce about 6.5 volts needed for the voltage limiting circuit. For 10 volt controls, the attenuator can be used. R2 is sized to deliver that same 6.5 volts from the 15 volt max from the ROM control. That gain is set to 0.44x (120K / 270K).

The MAX ROM header (HD1) is used to select the number of ROMs populated in the expander. This is important so that we limit the voltage used to select the ROM so that a selection is not made to an unpopulated ROM socket. That is done using the natural ~0.6 volt drop that appears across a silicon diode during conduction. My purpose in scaling this part of the circuit to ~ 6 volts was done intentionally to have 0.6 volts as the voltage for each step in the ROM selection process. So, for one ROM, I want to clamp the voltage at about 0.6 volts, for 2 ROMs about 1.2 volts, and so on. The selector applies a ground putting the same number of diodes in this series circuit as we have populated ROMs.

Don't forget, the U2A summing amp is an inverting amp. So, I am not clamping the positive voltage with the diode string, I am clamping the negative voltage. The diodes are placed anode to ground so they will conduct for negative voltages exceeding their combined threshold voltages. So, what happens to voltage over the clamped value delivered by the amp U2A? That voltage appears as a voltage drop across 1K resistor

R5. The purpose of R5 is to limit the current delivered by the op amp into the diodes when they short to ground, and to drop the unwanted voltage from appearing at the next amp.

Diode D2 limits the positive voltage at this point to 0.6 volts. This is in the circuit primarily to protect U1 from excess negative voltage delivered to its control input and to lessen the burden of our voltage limiting circuit in the next stage.

Op amp U2B is used for two purposes. First, it is used to invert the control voltage back to positive. The LED driver chip LM3914 requires a positive control voltage. Secondly, it is used to scale the voltage to the LM3914. So, this provided a perfect opportunity to insert the circuit's only trimmer. Since this stage sets the proper range, I have inserted a 2k trimmer (TP1). The gain of this inverting stage is about 0.80-0.85 x depending on the adjustment of the trimmer. This is just right to deliver 0-5 volts positive from amp U2B for control of the LM3914.

We have one more voltage limiting issue to deal with. If we let the voltage delivered to pin 5 of the LM3914 fall too low (below about 0.3 volts), then all the LEDs will be off and no ROM will be selected. We don't want that. So, to protect the circuit from being driven below the point of the first ROM being selected, we have D1, R10, and R11. R10 and R11 form a voltage divider used to establish the minimum voltage allowed to pass to LM3914. Once the output of U2B goes below that voltage (less the 0.6 volt drop across the diode) D1 turns on and holds the voltage above the low limit established so the LM3914 does not turn off the ROM=0 LED no matter how negative we attempt to drive the input.

Notice that this limiting circuit is located at the end of the voltage conditioning chain. We do want and need to allow negative control voltages at the input so we can use LFOs and other AC signals for ROM select utilizing the ROM select control for bias.

The LM3914 is an all-in-one LED driver. The scale is established by R12 and R13. I have it set for about 0.5 volts per change. Hence, 10 PROMs selected over a 5 volt range. Pins 2, 3, and 4 are power pins. To operate from a single supply (+15), the connections are +15 to pin 3 and pins 2 and 4 at ground. Pin 9 selects either "bar" or "dot" mode on the output. Obviously, we need "dot" mode so we do not have more than one LED on at a time. No connection is correct for dot mode. For bar mode, this would be connected to the same supply voltage as pin 3.

The 10 outputs on the LM3914 are designed to provide a current path to ground when turned on. So, the LEDs are connected to +5 volts with cathodes toward U1. When the output is turned on, current flows from ground through the IC through the diode and resistor to the +5 V power supply line. R14 limits the current in the LED. The 5V regulator U3 was installed to isolate the LED switching noise from the power line.

The way that PROMs are selected on the Miniwave is to ground the select pin. So, the output pins on the LM3914 are connected over to the ROM expander PCB where they

connect directly to the select pins on the PROMs. The output when turned ON by the LM3914 is not actually right at ground. However, it is close enough.

Additional Circuit Notes

U5B is a unity gain inverter for providing an inverted output from the MiniWave. TP2 adjusts the inverter for exactly unity gain.

U3 is a 5V regulator for driving the ROM selection LEDs and selecting the active ROM on the ROM expansion board. R16 is used to limit the voltage drop across the regulator so that it doesn't have to dissipate too much power. Typical values for R16 are between 51 and 150 ohms.

U4 is a 12V regulator for driving the MiniWave's four BANK and four WAVE LEDs. R17 can be used to limit the voltage drop across the regulator so that it doesn't have to dissipate too much power in the event that a 5V regulator is used for U4. For a 12V regulator, R17 should be replaced with a jumper. For 5V regulators, R17 will typically be in the 51 to 150 ohm range.

If U4 is not used, the MiniWave's four BANK and four WAVE LEDs can be driven from U3 (the 5V regulator). This can cause a lot of power to be dissipated across U3 when all BANK and WAVE LEDs are lit. R16 can be increased to dissipate more power if necessary. Z1 and Z2 (located between U3 and C3 on the PCB) are holes for attaching a jumper to bridge the two LED supplies. **This jumper should only be installed if U4 is not used**.

R19 – R26 are current limiting resistors for the MiniWave's four BANK and four WAVE LEDs. Set the values of these resistors to achieve whatever brightness you want.

R18 is used to shut off the LED for ROM 0. Refer to the LM3914 data sheet for more information on why this is necessary.

Construction Tips

Disconnect the four BANK and four WAVE LEDs from the MiniWave motherboard. Run a wire from where the cathode of each LED was connected on the motherboard up to JP2 on the JLH-2090CV. The 8 pins of JP2 are labeled B1 – B4 for the BANK LED cathodes, and W1 – W4 for the WAVE LED cathodes.

The PCB uses 0.4" spacing for the resistor pads, 0.4" spacing for the ferrite bead pads, 0.3" for the diode pads, and 0.2" spacing for most of the capacitor pads. The electrolytic caps have a 0.1" pad spacing. The LED connection points have a 0.1" spacing.

For VR1 and VR2, the square pad on the PCB indicates pin 1, the middle pad is pin 2, and the remaining pad is pin 3. The pin out for most pots is (left to right): 3, 2, 1 when viewing the back of the pot with the leads facing down.

For J4 – J6, the square pad on the PCB indicates the ground connection. Note that J4 is the MiniWave output jack, not a new jack.

For the LED connection points, the square pad indicates the cathode. The cathode is normally the shorter lead on an LED.

For SW1, the two wires connect to the middle and bottom lug. For SW2, the square pad on the PCB (labeled “P”) connects to the bottom lug, the middle pad connects to the middle lug, and the pad labeled “F” connects to the top lug.

Check the pin out for the 5V and 12V regulators before you install them. The silkscreen indicates the flat side of the regulators should be facing towards the edge of the PCB. The pin out I used is: output, ground, input reading from left to right with the flat side facing you and the pins pointing down. But some manufacturers may not adhere to this and may have the input and output swapped. Check before you solder.

JLH-2090CV Parts List

Resistors (30)

Quantity	*Description*	*Part No.*	*Notes*
1	4.7 K	R8	5% or better, Mouser #291-4.7K
1	8.2 K	R15	5% or better, Mouser #291-8.2K
1	10 K	R18	5% or better, Mouser #291-10K
1	39 K	R4	5% or better, Mouser #291-39K
1	47 K	R30	5% or better, Mouser #291-4.7K
1	100	R29	1%, Mouser #271-100
2	1 K	R5, R11	1%, Mouser #271-1K
1	1.37 K	R13	1%, Mouser #271-1.37K
1	3.9 K	R12	1%, Mouser #271-3.9K
3	10 K	R6, R7, R9	1%, Mouser #271-10K
1	14 K	R10	1%, Mouser #271-14K
1	93.1 K	R1	1%, Mouser #271-93.1K
1	97.6 K	R27	1%, Mouser #271-97.6K
1	100 K	R28	1%, Mouser #271-100K
1	120 K	R3	1%, Mouser #271-120K
1	270 K	R2	1%, Mouser #271-270K
		R14, R16, R17	see text
		R19 – R26	see text

Capacitors (10)

Quantity	*Description*	*Part No.*	*Notes*
1	33 pF ceramic	C10	Mouser #140-50N5-330J Mouser #147-75-330
5	0.1 uF ceramic	C5 – C9	Mouser #147-72-104 Mouser #581-SA105E104M
4	10 uF 35V electrolytic	C1 – C4	Mouser #140-XRL35V10

Semiconductors (35)

Quantity	*Description*	*Part No.*	*Notes*
1	LM3914 LED driver	U1	Digikey #LM3914N-1-ND
2	TL072 dual op amp	U2, U5	Mouser #595-TL072CP
1	LM7805 5V regulator	U3	Mouser #511-L78L05ACZ
1	LM7812 12V regulator	U4	Mouser #511-L78L12ACZ
12	1N4148 diode	D1 – D12	Mouser #512-1N4148 (can substitute 1N914)
18		LED1 – LED18	see text

Potentiometers & Trimmers (4)

Quantity	*Description*	*Part No.*	*Notes*
2	50 K linear pot	VR1, VR2	Bournes 91 series, Allied #754-9418
1	2 K trimmer (multi-turn)	TP1	Mouser #72-T93YA-2K
1	5 K trimmer (multi-turn)	TP2	Mouser #72-T93YA-5K

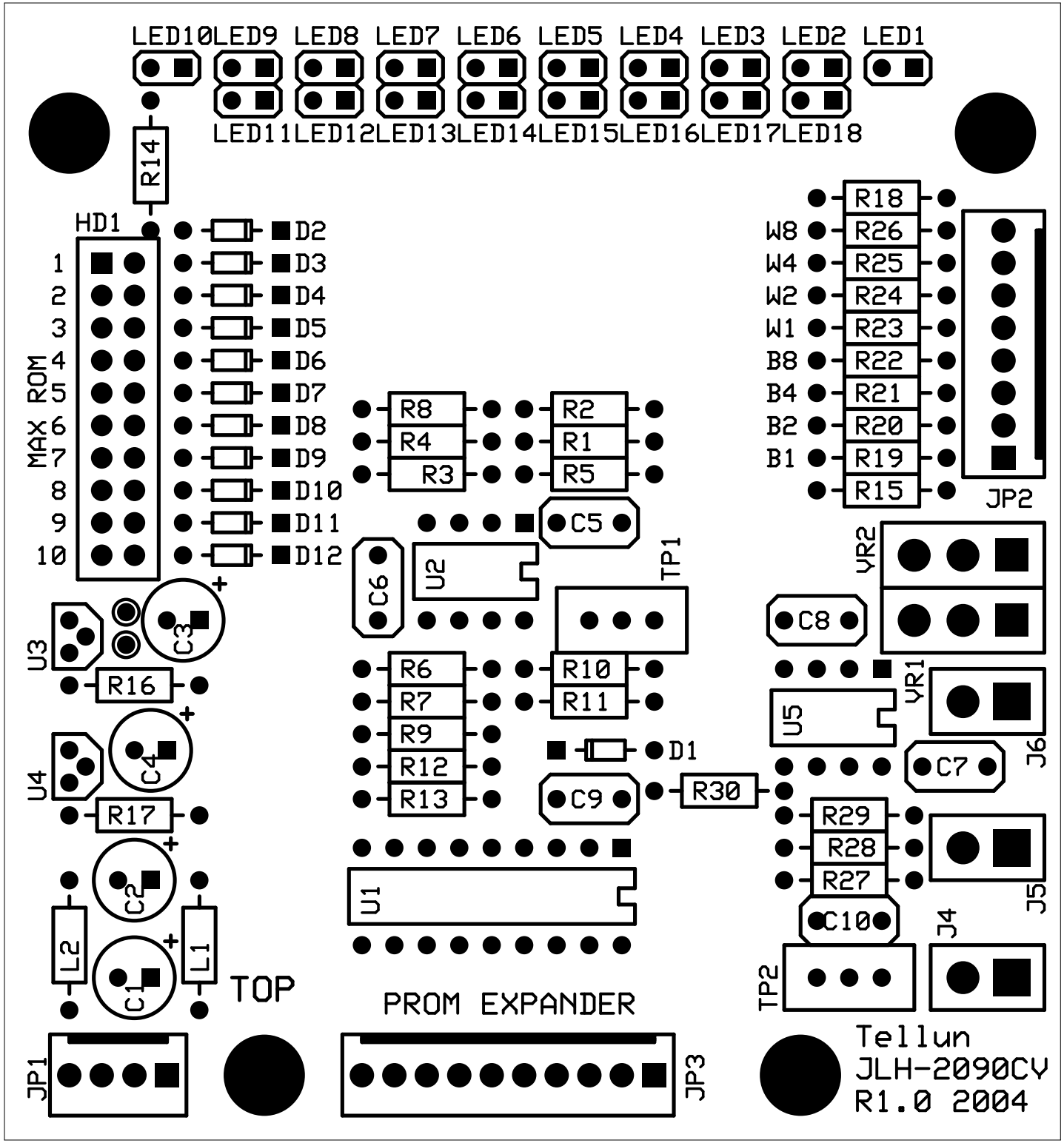
Miscellaneous

Quantity	*Description*	*Part No.*	*Notes*
2	phone jack	J5 – J6	Switchcraft 112A, Allied #932-9391 Mouser #512-112A
2	8 pin DIP socket		for U2, U5 (optional)
1	18 pin DIP socket		for U1 (optional)
2	axial ferrite beads	L1, L2	Active #MURJP2141, or Mouser #623-2743002112
1	MTA-100 4 pin	JP1	Mouser #571-6404564 (header) Mouser #571-6404404 (connector) Mouser #571-6405504 (dust cover)
1	MTA-100 8 pin	JP2	Mouser #571-6404568 (header) Mouser #571-6404408 (connector) Mouser #571-6405508 (dust cover)
1	MTA-100 10 pin	JP3	Mouser #571-16404560 (header) Mouser #571-16404400 (connector) Mouser #571-16405500 (dust cover)
1	2 row by 10 position 0.1” header	JHD1	Mouser #538-10-89-1201
1	2 pin shunt for HD1		Mouser #517-952-10 Mouser #151-8011

Hardware

Quantity	*Description*	*Notes*
2	knob	ALCO PKES90B1/4
1	JLH-2090CV PCB	printed circuit board
1	MiniWave panel	Stooge panel
2	single pot bracket	Stooge single pot bracket (for mounting daughterboard to panel)
	coax cable (RG174/U)	Mouser #566-8216-100 (100 foot spool)
	heat shrink cable	
	hookup wire	
	solder	both organic and no clean

Additional hardware is required to mount the daughterboard onto the two single pot brackets (screws, spacers, and nuts).


LED10 LED9 LED8 LED7 LED6 LED5 LED4 LED3 LED2 LED1
LED11 LED12 LED13 LED14 LED15 LED16 LED17 LED18
R14
HD1
1
2
3
4
5
6
7
8
9
10
MAX ROM
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
R18
W8
W4
W2
W1
B8
B4
B2
B1
R26
R25
R24
R23
R22
R21
R20
R19
R15
JP2
R8
R4
R3
R2
R1
R5
C5
C6
U2
TP1
VR2
C8
U3
C3
R16
R6
R7
R9
R12
R13
R10
R11
D1
C9
R30
U5
VR1
J6
C7
U4
C4
R17
R29
R28
R27
J5
C10
J4
TP2
L2
L1
C2
C1
U1
TOP
PROM EXPANDER
JP1
JP3
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