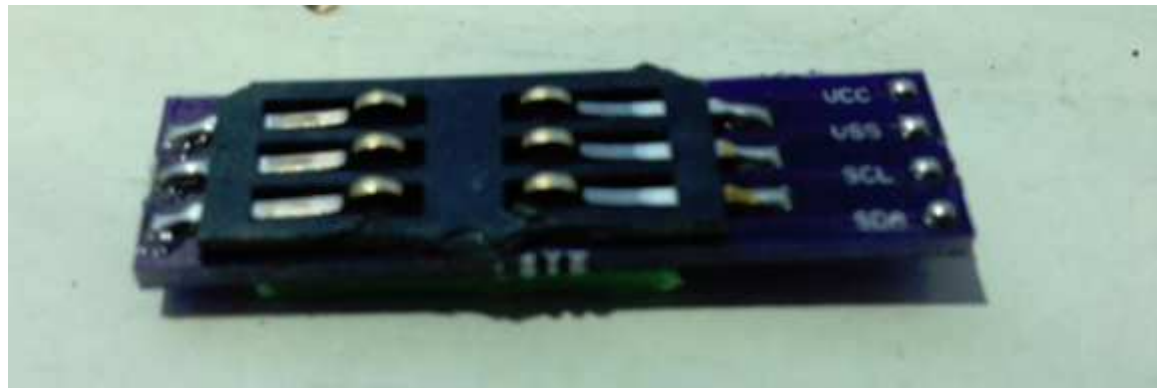


Hackaday

Cloning Tektronix Application Modules

July 28, 2014 By [Brian Benchoff](#)



Tektronix's MSO2000 line of oscilloscopes are great tools, and with the addition of a few 'application modules', can do some pretty interesting tasks: decoding serial protocols, embedded protocols like I2C and SPI, and automotive protocols like CAN and LIN. While testing out his MSO2012B, [jm] really like the (limited time) demo of the I2C decoder, but figured it wasn't worth the \$500 price the application module sells for. No matter, because it's just some data on a cheap 24c08 EEPROM, and with a little bit of PCB design [it's possible to build this module for under \\$5](#).

The application module Tektronix are selling is simply just a small EEPROM loaded up with an SKU. By writing this value to a \$0.25 EEPROM, [jm] can enable two applications. The only problem was getting his scope to read the EEPROM, a problem easily solved with a custom board.

The board [jm] designed [is available at OSH Park](#), with the only additional components needed being an EEPROM, a set of contacts for reading a SIM card, and a little bit of plastic glued onto the back of the board for proper spacing.

Hacktek

hacktek - Tektronix Application Module Hack

I purchased a new Tektronix MSO2012B Oscilloscope and quickly found utility in the demo I2C decoder for when I need to diagnose the failed controller in my hot tub. Before the demo period expired, I decided that the capability was rather compelling but didn't have money to purchase the actual application modules. This scope is used purely for hobbies and will never make a buck. After scraping the internet (and Google Translate) for information about this scope, I was able to produce my own Application Modules. It was a whole lot easier than I expected it to be.

After some investigation and trial/error I found that each application module can be enabled with up to two applications by writing the SKU of the application module (SKU can be found on the Tektronix website) onto a 24c08 eeprom.

Once this was proven, boards were created at OSHPark, a few parts purchased from Digikey and I now have a rather capable device.

For reference, dumps of the 24c08 are provided along with a part list to recreate this and my open source

board published on OSHPark

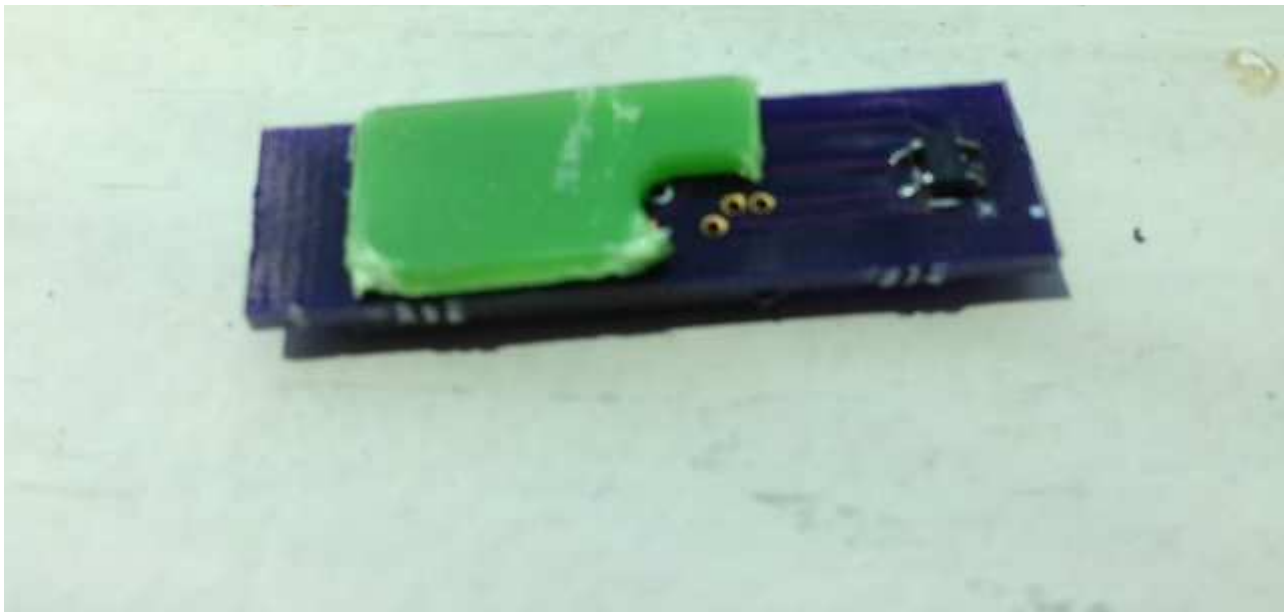
- 1x Haktek Module (\$3.00) - <https://oshpark.com/profiles/mchamster>
- 1x 24c08 (\$0.25) - Digikey - 24LC08BT-I/OTCT-ND
- 1x Sim holder (\$1.50) Digikey - 609-1401-1-ND
- 1x Spacer - Free

The 24c08 goes on the back of the board while the SIM holder will need to be trimmed to fit onto the board. Program the 24c08 by any means you have. I used a spare RaspberryPi. The I2C header to write to the module is labeled on the PCB.

To make it fit in the Tektronix, use a spacer to fill the gap between the PCB and the module bay. I initially used a piece of paper folded up but eventually found a scrap piece of plastic and glued it on.

What amazed me about this was Tektronix used no encryption, hashing or any other forms of authentication. It's just an EEPROM and for under \$5 I was able to enable functionality that was not initially exposed. This shouldn't even be considered hacking. It's synonymous to flipping a bit in a configuration file.





- Jm

Tektronix

Serial Bus	MDO/MSO/DPO 4000B Series Module	MDO3000 Series Module	MSO/DPO2000B Series Module
I ² C, SPI	DPO4EMBD	MDO3EMBD	DPO2EMBD
RS-232 / 422 / 485 / UART	DPO4COMP	MDO3COMP	DPO2COMP
CAN, LIN	DPO4AUTO	MDO3AUTO	DPO2AUTO
FlexRay	--	MDO3FLEX	--
CAN, LIN, FlexRay	DPO4AUTOMAX	--	--
I ² S/LJ/RJ/TDM	DPO4AUDIO	MDO3AUDIO	--
MIL-STD-1553	DPO4AERO	MDO3AERO	--
USB	DPO4USB	MDO3USB	--

Ethernet	DPO4ENET	--	--
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Discontinued products

Serial Bus	MDO4000 Series Module	MSO/DPO4000 Series Module	MSO/DPO3000 Series Module	MSO/DPO2000 Series Module
I ² C, SPI	DPO4EMBD	DPO4EMBD	DPO3EMBD	DPO2EMBD
RS-232 / 422 / 485 / UART	DPO4COMP	DPO4COMP	DPO3COMP	DPO2COMP
CAN, LIN	DPO4AUTO	DPO4AUTO	DPO3AUTO	DPO2AUTO
FlexRay	--	--	DPO3FLEX	--
CAN, LIN, FlexRay	DPO4AUTOMAX	DPO4AUTOMAX	--	--
I ² S/LJ/RJ/TDM	DPO4AUDIO	DPO4AUDIO	DPO3AUDIO	--
MIL-STD-1553	DPO4AERO	DPO4AERO	DPO3AERO	--
USB	DPO4USB	DPO4USB	--	--
Ethernet	DPO4ENET	--	--	--

OSH Park



Eagle File

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<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE eagle SYSTEM "eagle.dtd">
<eagle version="6.4">
<drawing>
<settings>
<setting alwaysvectorfont="no"/>
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```
<setting verticaltext="up"/>
</settings>
<grid distance="0.0125" unitdist="inch" unit="inch" style="dots" multiple="1" display="yes"
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<layer number="11" name="Route11" color="4" fill="7" visible="no" active="no"/>
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<layer number="27" name="tValues" color="7" fill="1" visible="yes" active="yes"/>
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<wire x1="35.54" y1="0" x2="35.54" y2="9.83" width="0" layer="20"/>
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</plain>
<libraries>
<library name="SparkFun-Connectors">
<description>&lt;h3&gt;SparkFun Electronics' preferred foot prints&lt;/h3&gt;
In this library you'll find connectors and sockets- basically anything that can be plugged into or
onto.&lt;br&gt;&lt;br&gt;
We've spent an enormous amount of time creating and checking these footprints and parts, but it is the
end user's responsibility to ensure correctness and suitability for a given componet or application. If you
enjoy using this library, please buy one of our products at www.sparkfun.com.
&lt;br&gt;&lt;br&gt;
&lt;b&gt;Licensing:&lt;/b&gt; CC v3.0 Share-Alike You are welcome to use this library for commercial
purposes. For attribution, we ask that when you begin to sell your device using our footprint, you email us
with a link to the product being sold. We want bragging rights that we helped (in a very small part) to
create your 8th world wonder. We would like the opportunity to feature your device on our homepage.
</description>
<packages>
<package name="SIMHOLDER3">
<smd name="2" x="0.91" y="7.41" dx="1.2" dy="2.2" layer="1" rot="R90"/>
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element14 CAD Library consolidation.ulp
at 30/07/2012 11:22:31</description>
<packages>
<package name="SOT95P270X145-5N">
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```

```

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</package>
</packages>
</library>
<library name="testpad">
<description>&lt;b&gt;Test Pins/Pads&lt;/b&gt;&lt;p&gt;
Cream on SMD OFF.&lt;br&gt;
new: Attribute TP_SIGNAL_NAME&lt;br&gt;
&lt;author&gt;Created by librarian@cadsoft.de&lt;/author&gt;</description>
<packages>
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<description>&lt;b&gt;TEST PAD&lt;/b&gt;</description>
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<text x="-0.508" y="-0.635" size="0.0254" layer="27">&gt;VALUE</text>
<text x="0" y="-2.54" size="1" layer="37">&gt;TP_SIGNAL_NAME</text>

```



```

</package>
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</libraries>
<attributes>
</attributes>
<variantdefs>
</variantdefs>
<classes>
<class number="0" name="default" width="0.3556" drill="0">
</class>
</classes>
<designrules name="default">
<description language="de">&lt;b&gt;EAGLE Design Rules&lt;/b&gt;
&lt;p&gt;
Die Standard-Design-Rules sind so gew&lt;h&gt;lt, dass sie f&lt;u&gt;ur
die meisten Anwendungen passen. Sollte ihre Platine
besondere Anforderungen haben, treffen Sie die erforderlichen
Einstellungen hier und speichern die Design Rules unter
einem neuen Namen ab.</description>
<description language="en">&lt;b&gt;EAGLE Design Rules&lt;/b&gt;
&lt;p&gt;
The default Design Rules have been set to cover
a wide range of applications. Your particular design
may have different requirements, so please make the
necessary adjustments and save your customized
design rules under a new name.</description>
<param name="layerSetup" value="(1*16)"/>
<param name="mtCopper" value="0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm
0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm 0.035mm"/>
<param name="mtIsolate" value="1.5mm 0.15mm 0.2mm 0.15mm 0.2mm 0.15mm 0.2mm 0.15mm
0.2mm 0.15mm 0.2mm 0.15mm 0.2mm 0.15mm 0.2mm"/>
<param name="mdWireWire" value="8mil"/>
<param name="mdWirePad" value="8mil"/>
<param name="mdWireVia" value="8mil"/>
<param name="mdPadPad" value="8mil"/>
<param name="mdPadVia" value="8mil"/>
<param name="mdViaVia" value="8mil"/>
<param name="mdSmdPad" value="8mil"/>
<param name="mdSmdVia" value="8mil"/>
<param name="mdSmdSmd" value="8mil"/>
<param name="mdViaViaSameLayer" value="8mil"/>
<param name="mnLayersViaInSmd" value="2"/>
<param name="mdCopperDimension" value="40mil"/>
<param name="mdDrill" value="8mil"/>
<param name="mdSmdStop" value="0mil"/>
<param name="msWidth" value="10mil"/>
<param name="msDrill" value="24mil"/>
<param name="msMicroVia" value="9.99mm"/>
<param name="msBlindViaRatio" value="0.5"/>
<param name="rvPadTop" value="0.25"/>
<param name="rvPadInner" value="0.25"/>
<param name="rvPadBottom" value="0.25"/>
<param name="rvViaOuter" value="0.25"/>

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<param name="rvViaInner" value="0.25"/>
<param name="rvMicroViaOuter" value="0.25"/>
<param name="rvMicroViaInner" value="0.25"/>
<param name="rlMinPadTop" value="10mil"/>
<param name="rlMaxPadTop" value="20mil"/>
<param name="rlMinPadInner" value="10mil"/>
<param name="rlMaxPadInner" value="20mil"/>
<param name="rlMinPadBottom" value="10mil"/>
<param name="rlMaxPadBottom" value="20mil"/>
<param name="rlMinViaOuter" value="8mil"/>
<param name="rlMaxViaOuter" value="20mil"/>
<param name="rlMinViaInner" value="8mil"/>
<param name="rlMaxViaInner" value="20mil"/>
<param name="rlMinMicroViaOuter" value="4mil"/>
<param name="rlMaxMicroViaOuter" value="20mil"/>
<param name="rlMinMicroViaInner" value="4mil"/>
<param name="rlMaxMicroViaInner" value="20mil"/>
<param name="psTop" value="-1"/>
<param name="psBottom" value="-1"/>
<param name="psFirst" value="-1"/>
<param name="psElongationLong" value="100"/>
<param name="psElongationOffset" value="100"/>
<param name="mvStopFrame" value="1"/>
<param name="mvCreamFrame" value="0"/>
<param name="mlMinStopFrame" value="4mil"/>
<param name="mlMaxStopFrame" value="4mil"/>
<param name="mlMinCreamFrame" value="0mil"/>
<param name="mlMaxCreamFrame" value="0mil"/>
<param name="mlViaStopLimit" value="0mil"/>
<param name="srRoundness" value="0"/>
<param name="srMinRoundness" value="0mil"/>
<param name="srMaxRoundness" value="0mil"/>
<param name="slThermalIsolate" value="10mil"/>
<param name="slThermalsForVias" value="0"/>
<param name="dpMaxLengthDifference" value="10mm"/>
<param name="dpGapFactor" value="2.5"/>
<param name="checkGrid" value="0"/>
<param name="checkAngle" value="0"/>
<param name="checkFont" value="1"/>
<param name="checkRestrict" value="1"/>
<param name="useDiameter" value="13"/>
<param name="maxErrors" value="50"/>
</designrules>
<autorouter>
<pass name="Default">
<param name="RoutingGrid" value="10mil"/>
<param name="tpViaShape" value="round"/>
<param name="PrefDir.1" value="*"/>
<param name="PrefDir.2" value="0"/>
<param name="PrefDir.3" value="0"/>
<param name="PrefDir.4" value="0"/>
<param name="PrefDir.5" value="0"/>
<param name="PrefDir.6" value="0"/>
<param name="PrefDir.7" value="0"/>
```

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<param name="PrefDir.8" value="0"/>
<param name="PrefDir.9" value="0"/>
<param name="PrefDir.10" value="0"/>
<param name="PrefDir.11" value="0"/>
<param name="PrefDir.12" value="0"/>
<param name="PrefDir.13" value="0"/>
<param name="PrefDir.14" value="0"/>
<param name="PrefDir.15" value="0"/>
<param name="PrefDir.16" value="*/>
<param name="cfVia" value="8"/>
<param name="cfNonPref" value="5"/>
<param name="cfChangeDir" value="2"/>
<param name="cfOrthStep" value="2"/>
<param name="cfDiagStep" value="3"/>
<param name="cfExtdStep" value="0"/>
<param name="cfBonusStep" value="1"/>
<param name="cfMalusStep" value="1"/>
<param name="cfPadImpact" value="4"/>
<param name="cfSmdImpact" value="4"/>
<param name="cfBusImpact" value="0"/>
<param name="cfHugging" value="3"/>
<param name="cfAvoid" value="4"/>
<param name="cfPolygon" value="10"/>
<param name="cfBase.1" value="0"/>
<param name="cfBase.2" value="1"/>
<param name="cfBase.3" value="1"/>
<param name="cfBase.4" value="1"/>
<param name="cfBase.5" value="1"/>
<param name="cfBase.6" value="1"/>
<param name="cfBase.7" value="1"/>
<param name="cfBase.8" value="1"/>
<param name="cfBase.9" value="1"/>
<param name="cfBase.10" value="1"/>
<param name="cfBase.11" value="1"/>
<param name="cfBase.12" value="1"/>
<param name="cfBase.13" value="1"/>
<param name="cfBase.14" value="1"/>
<param name="cfBase.15" value="1"/>
<param name="cfBase.16" value="0"/>
<param name="mnVias" value="20"/>
<param name="mnSegments" value="9999"/>
<param name="mnExtdSteps" value="9999"/>
<param name="mnRipupLevel" value="10"/>
<param name="mnRipupSteps" value="100"/>
<param name="mnRipupTotal" value="100"/>
</pass>
<pass name="Follow-me" refer="Default" active="yes">
</pass>
<pass name="Busses" refer="Default" active="yes">
<param name="cfNonPref" value="4"/>
<param name="cfBusImpact" value="4"/>
<param name="cfHugging" value="0"/>
<param name="mnVias" value="0"/>
</pass>
```

```
<pass name="Route" refer="Default" active="yes">
</pass>
<pass name="Optimize1" refer="Default" active="yes">
<param name="cfVia" value="99"/>
<param name="cfExtdStep" value="10"/>
<param name="cfHugging" value="1"/>
<param name="mnExtdSteps" value="1"/>
<param name="mnRipupLevel" value="0"/>
</pass>
<pass name="Optimize2" refer="Optimize1" active="yes">
<param name="cfNonPref" value="0"/>
<param name="cfChangeDir" value="6"/>
<param name="cfExtdStep" value="0"/>
<param name="cfBonusStep" value="2"/>
<param name="cfMalusStep" value="2"/>
<param name="cfPadImpact" value="2"/>
<param name="cfSmdImpact" value="2"/>
<param name="cfHugging" value="0"/>
</pass>
<pass name="Optimize3" refer="Optimize2" active="yes">
<param name="cfChangeDir" value="8"/>
<param name="cfPadImpact" value="0"/>
<param name="cfSmdImpact" value="0"/>
</pass>
<pass name="Optimize4" refer="Optimize3" active="yes">
<param name="cfChangeDir" value="25"/>
</pass>
</autorouter>
<elements>
<element name="U$1" library="SparkFun-Connectors" package="SIMHOLDER3"
value="SIMHOLDER3" x="0.635" y="-2.54"/>
<element name="." library="Microchip_By_element14_Batch_1" package="SOT95P270X145-5N"
value="24LC08BT-I/OT" x="31.115" y="5.08" rot="MR0">
<attribute name="PACKAGE" value="SOT23-5" x="31.115" y="5.08" size="1.778" layer="28"
rot="MR0" display="off"/>
<attribute name="OC_NEWARK" value="62K0577" x="31.115" y="5.08" size="1.778" layer="28"
rot="MR0" display="off"/>
<attribute name="MPN" value="24LC08BT-I/OT" x="31.115" y="5.08" size="1.778" layer="28"
rot="MR0" display="off"/>
<attribute name="SUPPLIER" value="MICROCHIP" x="31.115" y="5.08" size="1.778" layer="28"
rot="MR0" display="off"/>
<attribute name="OC_FARNELL" value="1556163" x="31.115" y="5.08" size="1.778" layer="28"
rot="MR0" display="off"/>
</element>
<element name="VCC" library="testpad" package="TP12SQ" value="TPSQTP12SQ" x="34.29"
y="8.5725" smashed="yes">
<attribute name="TP_SIGNAL_NAME" value="" x="34.29" y="6.6675" size="1" layer="37"/>
<attribute name="NAME" x="30.4975" y="8.0201" size="0.8128" layer="25"/>
<attribute name="VALUE" x="33.909" y="8.0645" size="0.0254" layer="27"/>
</element>
<element name="SCL" library="testpad" package="TP12SQ" value="TPSQTP12SQ" x="34.29"
y="3.81" smashed="yes">
<attribute name="TP_SIGNAL_NAME" value="" x="34.29" y="1.905" size="1" layer="37"/>
<attribute name="NAME" x="30.4975" y="3.2576" size="0.8128" layer="25"/>
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<attribute name="VALUE" x="33.909" y="3.302" size="0.0254" layer="27"/>
</element>
<element name="VSS" library="testpad" package="TP12SQ" value="TPSQTP12SQ" x="34.29"
y="6.35" smashed="yes">
<attribute name="TP_SIGNAL_NAME" value="" x="34.29" y="4.445" size="1" layer="37"/>
<attribute name="NAME" x="30.4975" y="5.7976" size="0.8128" layer="25"/>
<attribute name="VALUE" x="33.909" y="5.842" size="0.0254" layer="27"/>
</element>
<element name="SDA" library="testpad" package="TP12SQ" value="TPSQTP12SQ" x="34.29"
y="1.27" smashed="yes">
<attribute name="TP_SIGNAL_NAME" value="" x="34.29" y="-0.635" size="1" layer="37"/>
<attribute name="NAME" x="30.4975" y="0.7176" size="0.8128" layer="25"/>
<attribute name="VALUE" x="33.909" y="0.762" size="0.0254" layer="27"/>
</element>
</elements>
<signals>
<signal name="GND">
<contactref element="U$1" pad="5"/>
<contactref element="." pad="2"/>
<contactref element="." pad="5"/>
<contactref element="VSS" pad="TP"/>
<wire x1="30.48" y1="5.842" x2="29.972" y2="5.842" width="0.3556" layer="16"/>
<wire x1="31.242" y1="5.08" x2="30.48" y2="5.842" width="0.3556" layer="16"/>
<wire x1="32.4866" y1="5.08" x2="31.242" y2="5.08" width="0.3556" layer="16"/>
<wire x1="29.972" y1="5.842" x2="29.7434" y2="6.0198" width="0.3556" layer="16"/>
<wire x1="28.448" y1="6.35" x2="34.29" y2="6.35" width="0.3556" layer="1"/>
<wire x1="26.924" y1="4.826" x2="28.194" y2="6.096" width="0.3556" layer="1"/>
<wire x1="28.194" y1="6.096" x2="28.448" y2="6.35" width="0.3556" layer="1"/>
<wire x1="26.924" y1="4.826" x2="26.855" y2="4.8" width="0.3556" layer="1"/>
<wire x1="22.606" y1="6.096" x2="29.718" y2="6.096" width="0.3556" layer="16"/>
<wire x1="28.194" y1="6.096" x2="22.606" y2="6.096" width="0.3556" layer="1"/>
<wire x1="29.718" y1="6.096" x2="29.7434" y2="6.0198" width="0.3556" layer="16"/>
<via x="22.606" y="6.096" extent="1-16" drill="0.6096"/>
</signal>
<signal name="N$1">
<contactref element="U$1" pad="1"/>
<contactref element="." pad="1"/>
<contactref element="SCL" pad="TP"/>
<wire x1="3.302" y1="3.81" x2="20.32" y2="3.81" width="0.3556" layer="1"/>
<wire x1="20.32" y1="3.81" x2="34.29" y2="3.81" width="0.3556" layer="1"/>
<wire x1="1.778" y1="2.286" x2="3.302" y2="3.81" width="0.3556" layer="1"/>
<wire x1="1.778" y1="2.286" x2="1.585" y2="2.27" width="0.3556" layer="1"/>
<wire x1="31.242" y1="6.096" x2="32.258" y2="6.096" width="0.3556" layer="16"/>
<wire x1="30.226" y1="7.112" x2="31.242" y2="6.096" width="0.3556" layer="16"/>
<wire x1="20.32" y1="7.112" x2="30.226" y2="7.112" width="0.3556" layer="16"/>
<wire x1="20.32" y1="3.81" x2="20.32" y2="7.112" width="0.3556" layer="1"/>
<wire x1="32.258" y1="6.096" x2="32.4866" y2="6.0198" width="0.3556" layer="16"/>
<via x="20.32" y="7.112" extent="1-16" drill="0.6096"/>
</signal>
<signal name="N$2">
<contactref element="U$1" pad="3"/>
<contactref element="." pad="3"/>
<contactref element="SDA" pad="TP"/>
<wire x1="23.368" y1="1.27" x2="34.29" y2="1.27" width="0.3556" layer="1"/>
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<wire x1="22.606" y1="2.032" x2="23.368" y2="1.27" width="0.3556" layer="1"/>
<wire x1="30.226" y1="2.032" x2="22.606" y2="2.032" width="0.3556" layer="16"/>
<wire x1="32.258" y1="4.064" x2="30.226" y2="2.032" width="0.3556" layer="16"/>
<wire x1="32.258" y1="4.064" x2="32.4866" y2="4.1402" width="0.3556" layer="16"/>
<wire x1="17.272" y1="7.112" x2="1.778" y2="7.112" width="0.3556" layer="1"/>
<wire x1="22.352" y1="2.032" x2="17.272" y2="7.112" width="0.3556" layer="16"/>
<wire x1="22.606" y1="2.032" x2="22.352" y2="2.032" width="0.3556" layer="16"/>
<wire x1="1.778" y1="7.112" x2="1.585" y2="7.32" width="0.3556" layer="1"/>
<via x="22.606" y="2.032" extent="1-16" drill="0.6096"/>
<via x="17.272" y="7.112" extent="1-16" drill="0.6096"/>
</signal>
<signal name="N$3">
<contactref element="U$1" pad="2"/>
<contactref element="." pad="4"/>
<contactref element="VCC" pad="TP"/>
<wire x1="19.812" y1="8.382" x2="21.336" y2="8.382" width="0.3556" layer="1"/>
<wire x1="21.336" y1="8.382" x2="34.29" y2="8.382" width="0.3556" layer="1"/>
<wire x1="16.51" y1="5.08" x2="19.812" y2="8.382" width="0.3556" layer="1"/>
<wire x1="1.778" y1="5.08" x2="16.51" y2="5.08" width="0.3556" layer="1"/>
<wire x1="34.29" y1="8.382" x2="34.29" y2="8.5725" width="0.3556" layer="1"/>
<wire x1="1.778" y1="5.08" x2="1.545" y2="4.87" width="0.3556" layer="1"/>
<wire x1="23.114" y1="4.318" x2="29.718" y2="4.318" width="0.3556" layer="16"/>
<wire x1="21.336" y1="6.096" x2="23.114" y2="4.318" width="0.3556" layer="16"/>
<wire x1="21.336" y1="8.382" x2="21.336" y2="6.096" width="0.3556" layer="1"/>
<wire x1="29.718" y1="4.318" x2="29.7434" y2="4.1402" width="0.3556" layer="16"/>
<via x="21.336" y="6.096" extent="1-16" drill="0.6096"/>
</signal>
</signals>
</board>
</drawing>
</eagle>
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