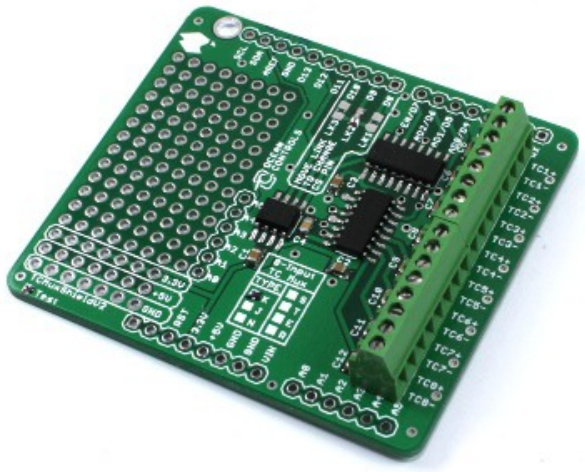
KTA-259v4 Thermocouple Multiplexer Shield



- Add up to 8 Thermocouples to an Arduino
- Cold Junction Compensated Output
- K, J, N, S, T, E or R Type thermocouples supported dependent on model
- 0.1” (2.54mm) Pitch Screw Terminals for Thermocouple connection
- 14-bit 0.25°C Resolution
- Nominal ±2°C Accuracy[1]
- Based on MAX31855 Cold-Junction Compensated Thermocouple-to-Digital Converter and ADG608 Multiplexer IC
- 13 x 8 Prototyping Area with Analog, I²C and Power pins
- Chip Select Pin Jumper Selectable means multi SPI shield compatibility
- Combine with SD card shield for powerful Temperature Logging
- Powered from 3.3V Arduino Pin, 5V compatible

Based on the MAX31855 cold junction compensated thermocouple to digital converter from Maxim Integrated, the new KTA-259 Thermocouple Multiplexer Shield is designed to easily allow multiple high temperature readings with an Arduino control board. With the new version there is are multiple advantages over the old KTA-259, namely, wider temperature range, higher accuracy, higher resolution and ability to use more thermocouple types (dependent on model).
A sample Arduino sketch is provided to read the temperatures from 8 themocouples as well as the internal cold junction temperature of the MAX31855 and send these to a serial terminal emulation program.
Screw terminals are provided for thermocouple connections as thermocouple wires can not be soldered.

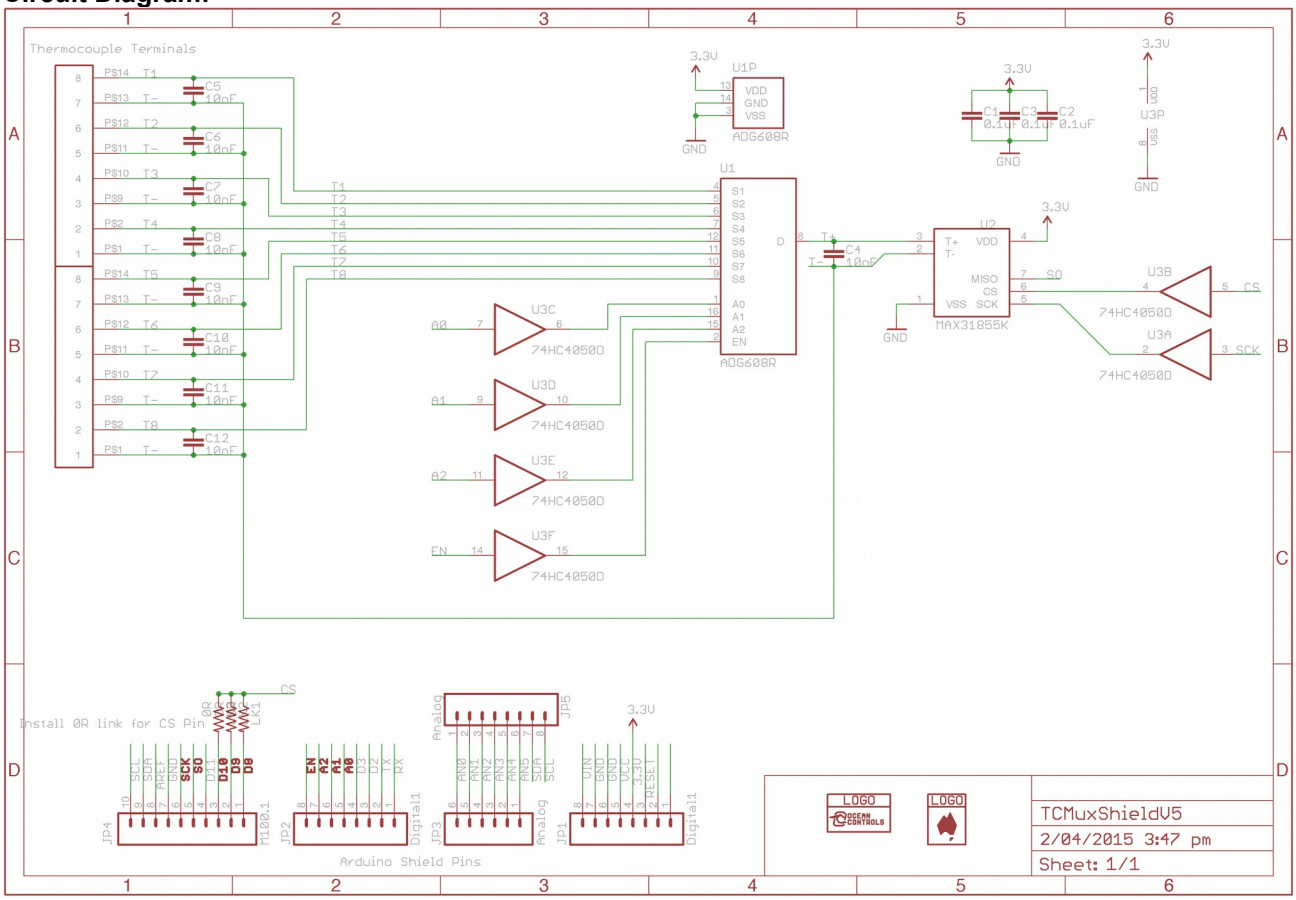
Uses:

Automotive – Engine, Exhaust and Brake temperatures are higher than most temperature sensors can handle, but within the range of Thermocouples.
Ovens, Furnaces and Kilns – At temperatures where other temperature sensors will not operate.
Chemical Processes – Where corrosive chemicals may damage probes or reach high temperatures thermocouples are more readily available for such processes.
Multi-Zone Temperature Monitoring, Data Acquisition or Logging Systems– With cheap readily available thermocouples.

Notes:

1. The MAX31855 datasheet specifies ±2 °C for all thermocouple types within the range -20 to 85 °C, not including thermocouple non-linearity or CJC temperature measurement uncertainty. This also doesn't include the effect of the multiplexer or the KTA-259 board layout.
2. The temperature sensor used for the cold junction compensation is internal to the MAX31855 IC and is not directly at the input terminals therefore temperature gradients across the KTA-259 device should be avoided.
3. The MAX31855 assumes a linear relationship between temperature and voltage. All thermocouples exhibit some level of non-linearity. A linear model of the thermocouple voltage works reasonably well for temperature ranges from zero to a few hundred degrees but is increasingly inaccurate for negative or high temperatures. The MAX31855K, for example, reports -100 °C as about -85 °C. You can correct for this with clever programming: you can use the linear model to get from the reported temperature to the thermocouple voltage, then use your own model or table to calculate the temperature. The example sketch doesn't do any correction and reports the temperature as measured by the MAX31855.
4. The KTA-259 is not specified to measure temperatures below the cold junction temperature (i.e. below room-temperature) but most of the shipped boards have no problem doing so.
   The analog multiplexer used is the ADG608. This is run from GND and 3.3V rails. A thermocouple with its sensing end colder than the terminal end will produce a negative voltage. This negative voltage will be outside the rails of the multiplexer and so is outside the specified operating range for the chip.
   The multiplexer isn't rated to pass negative voltages but in testing we found that almost all the KTA-259 boards work without issue. (It appears to depend on the batch of multiplexers.) The thermocouple voltage is very small (less than 100 mV), so it generally passes through the multiplexer unaffected.
   The amount the multiplexer affects the measurement will probably be proportional to the magnitude of the negative voltage.
5. This is the range of temperatures that a thermocouple of this type can measure, the Measured Temperature Range is the actual range the MAX31855 can digitise.

Circuit Diagram:



Ordering Information:

Each KTA-259 Device can take 8 thermocouples of one particular type, when using different thermocouple types multiple KTA-259 Devices must be used.

Ocean Controls SKU / Part Number	Thermocouple Type	IC	MAX31855 Temperature Range	Thermocouple Maximum Temperature Range [5]
KTA-259K	K	MAX31855K	-200°C to +1350°C	-270°C to +1372°C
KTA-259J	J	MAX31855J	-40°C to +750°C	-210°C to +1200°C
KTA-259N	N	MAX31855N	-200°C to + 1300°C	-270°C to +1300°C
KTA-259S	S	MAX31855S	+50°C to +1600°C	+50°C to +1768°C
KTA-259T	T	MAX31855T	-250°C to +400°C	-270°C to +400°C
KTA-259E	E	MAX31855E	-40°C to +900°C	-270°C to +1000°C
KTA-259R	R	MAX31855R	-50°C to +1770°C	-50°C to +1768°C

Revision History

Version	Notes
V1	KTA-259 and KTB-259 using MAX6675 and MAX6674
V2	First version with MAX31855 series of chips
V3	Updated table underneath PCB to have measured temp range instead of max temp range
V4	Broke connection between SDA/A4 and SCL/A5 and added new breakout holes for SDA/SCL
V5	Schematic clean up; no electrical changes