An Innovative Burn-in Board Design Approach for I2C Devices Receiving Data Instruction

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OUTLINE

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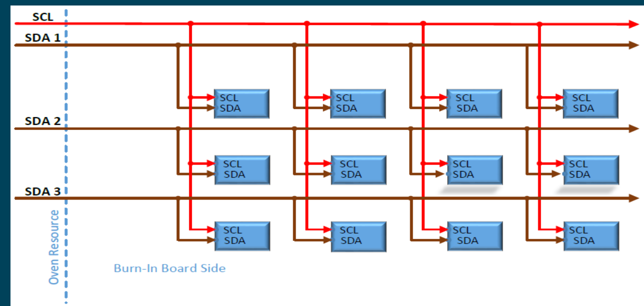
- Recommendation

INTRODUCTION

- Power supply and digital lines in burn-in boards (BIB) are commonly shared by all devices loaded on it. Sharing of digital line resources such as SDI, SCLK, and CS in SPI devices (Serial Parallel Interface) that needs to be written with data instruction doesn't have any issue on this configuration. But for I2C devices on the BIB with identical address, these can't just simply be shared by their digital lines, SDA and SCLK. This is because they are sending acknowledge bit signals on the same line where the data instruction is sent which is SDA. This was the challenge for I2C devices in BIB such as AD8158.



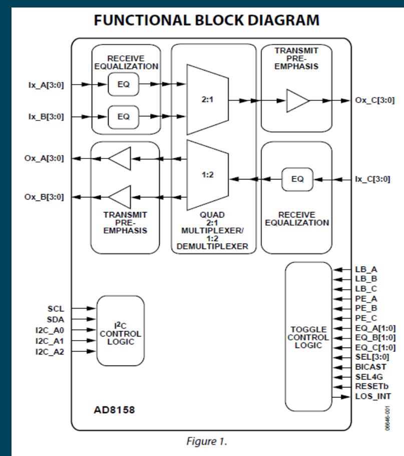
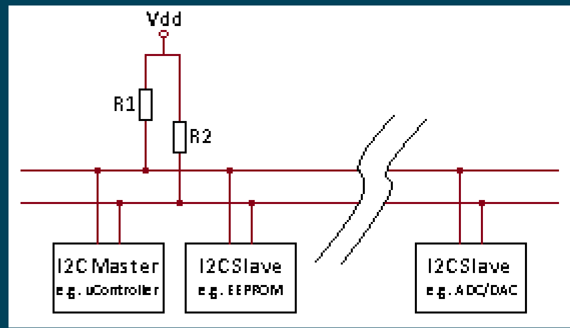
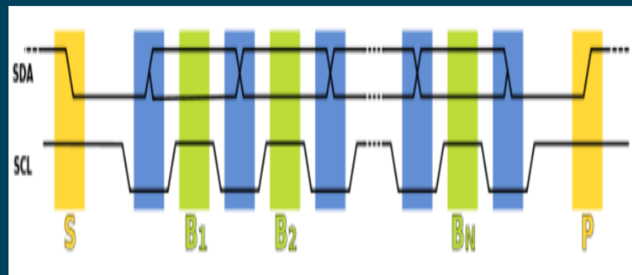


Figure 1.

INTRODUCTION

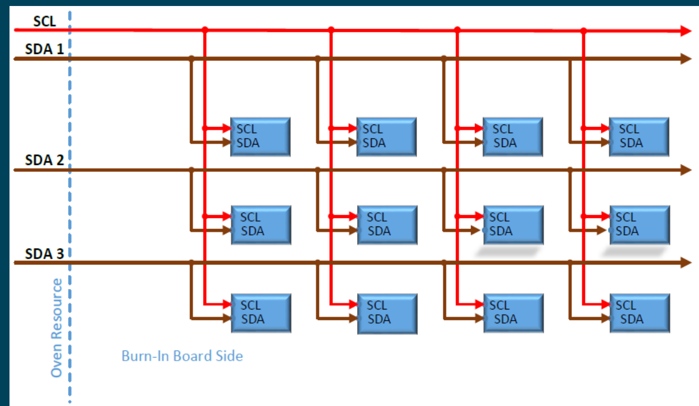
- I2C is a serial protocol for two-wire interface to connect devices like microcontrollers, EEPROMS, A/D and D/A converters, I/O interfaces and other similar peripherals in embedded system. It was invented by Philips and now it is used by almost all major IC manufacturers. Each I2C slave device needs an address – they must still be obtained from NXP (formerly Philips semiconductors)[1]
- Basic I2C communication is using transfers of 8 bits. Most I2C devices support repeated start condition. This means that before the communication ends with a stop condition, master device can repeat start condition with address byte and change the mode from writing to reading.





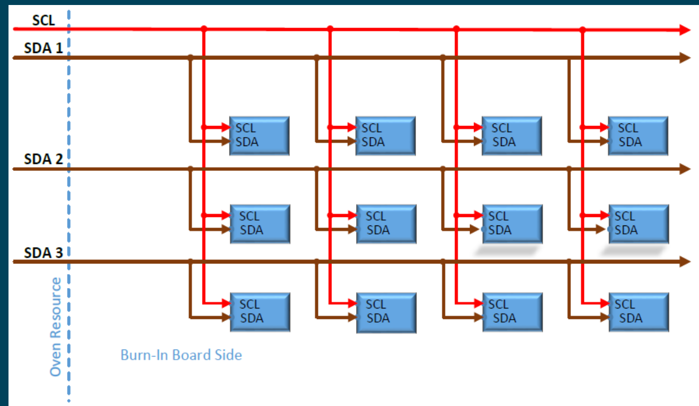
INTRODUCTION

- Typical burn-in solution for ADI parts that are running in I2C protocol is to write data instructions on them to make it in operational mode for Reliability burn-in qualification such HTOL, LTOL and ELF.
- And for THB or HAST most of I2C device being written as well to power down the device during initialization of the parts and this is dynamic initialization in burn-in.
- I2C configuration applied in burn-in with the intention of writing data instruction only on the device. SCL signal line is common to all device on burn-in board and SDA signal lines are distributed into group of 8 devices



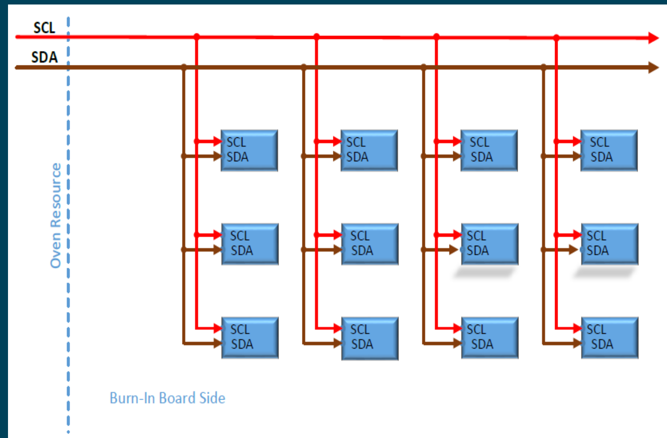
INTRODUCTION

- All the devices in the burn-in board were set to have same address so group of 8 devices on SDA signal is implemented to minimize capacitive loading and avoid clashes of data during the acknowledgement of the device.
- But, in some cases group of 4 is implemented because some I2C device do not allow more 4 device with same address be connected. Resources we have in our Oven for I2C communication which is mostly pattern/vector generators are limited to sending data instruction only, therefore in this configuration the acknowledge bit sent by the devices on the board are ignored.



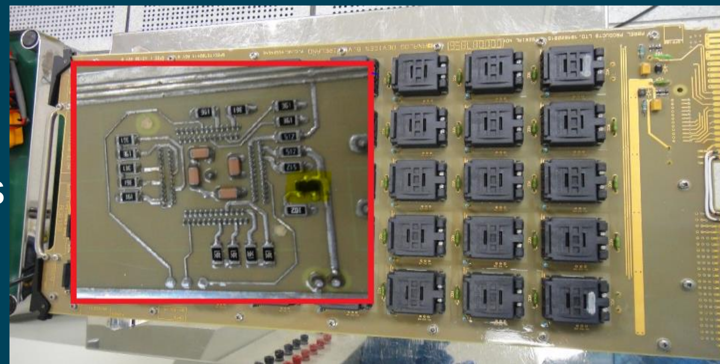
BACKGROUND

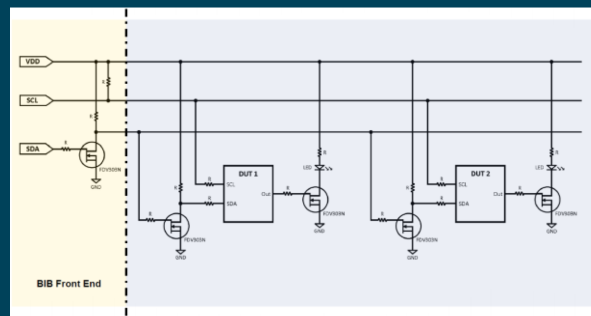
- HEP-6 and ENDZONE Oven have enough clock pattern resources that can cater the number of SDA signal lines required on the boards with I2C configuration on but some of our burn-in oven can't support this like most of HAST and THB ovens.
- I2C configuration on the new burn-in solution where only two clock pattern resources are required. This eliminates the limitation of those ovens having limited number of resources to run I2C devices.



BACKGROUND

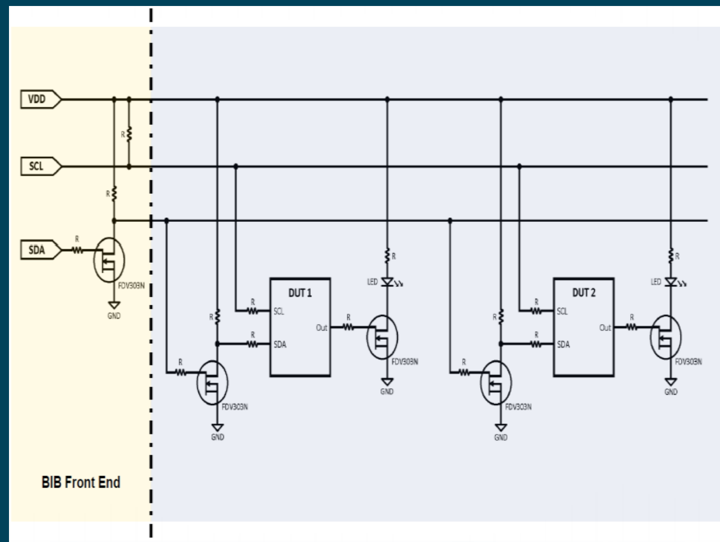
- Burn-in board design approach that supports I2C configuration in burn-in with only two clock pattern resources. With the n-channel MosFet driving the SDA on each DUT, it simply isolates them to the rest of device and negates the impact of capacitive loading which allows multiple I2C device slave connected to single SDA clock pattern generator. As all devices on BIB have the same address, they all send acknowledge bit at almost the same time, MosFet prevents clashing of data during this time.





BACKGROUND

- This n-channel MosFet inverts the SDA data therefore, another n-channel MosFet in front-end of the SDA signal line was placed. And to easily know whether the device accept and performs the data instructions, LED indicator circuit can be added which can be driven by the device output pin that can tell whether we are having good or bad condition.



METHODOLOGY

- Materials

HAST OVEN

Qual Vehicle

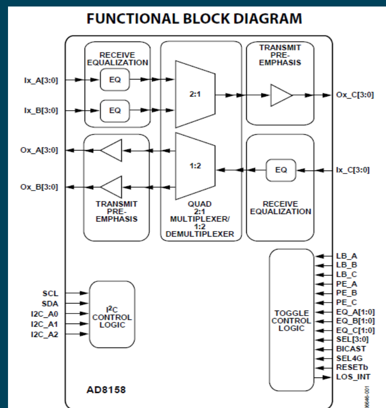
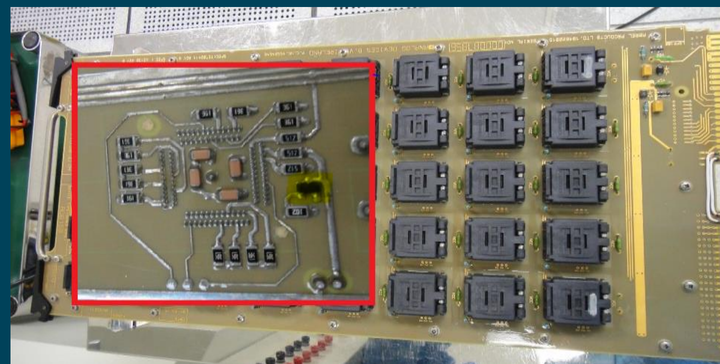


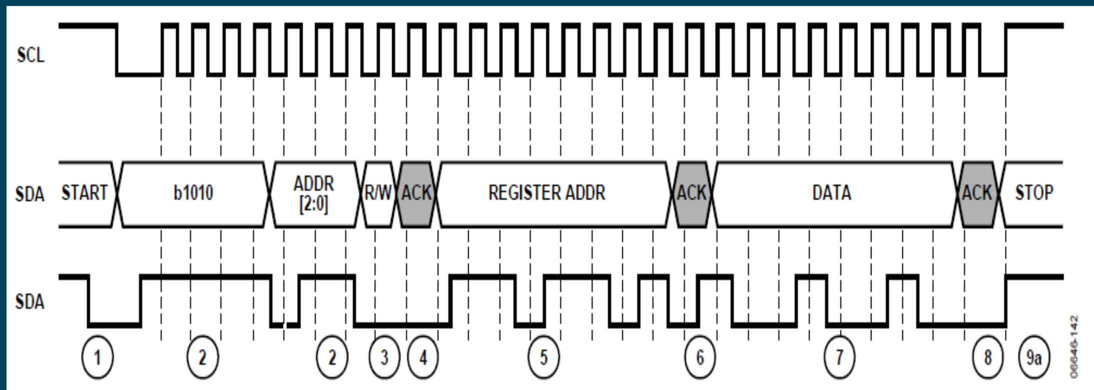
Figure 1.

Burn-in Board



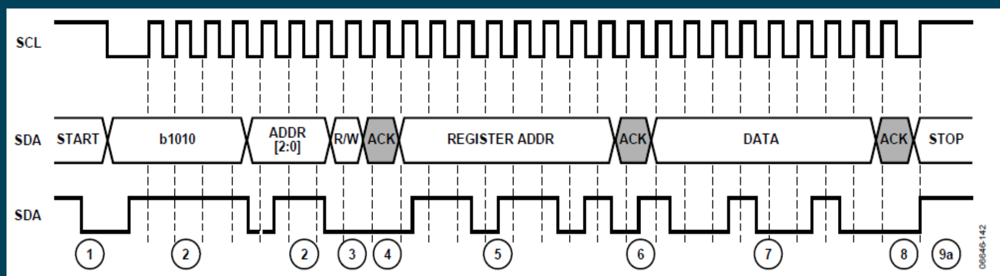
METHODOLOGY

- The experiment was done during set-up qualification of AD8158[2]. Dynamic initialization was applied to the fully loaded BIB, to put all devices in it to power down state for HAST qual.



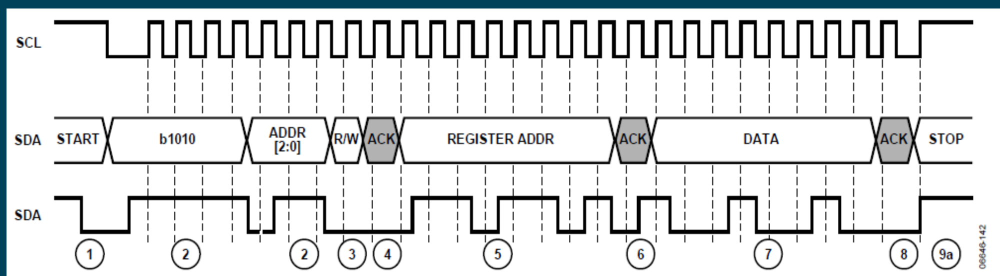
METHODOLOGY

1) Send a start condition (while holding the SCL line high, pull the SDA line low).
2) Send the AD8158 part address (seven bits) whose upper four bits are the static value b1010 and whose lower three bits are controlled by the I2C_A[2:0] input pins.
3) Send the write indicator bit (0).
4) Wait for the AD8158 to acknowledge the request.



METHODOLOGY

5) Send the register address (eight bits) to which data is to be written.
6) Wait for the AD8158 to acknowledge the request.
7) Send the data (eight bits) to be written to the register whose address was set in Step 5.
8) Wait for the AD8158 to acknowledge the request.
9) Send a stop condition (while holding the SCL line high, pull the SDA line high) and release control of the bus.



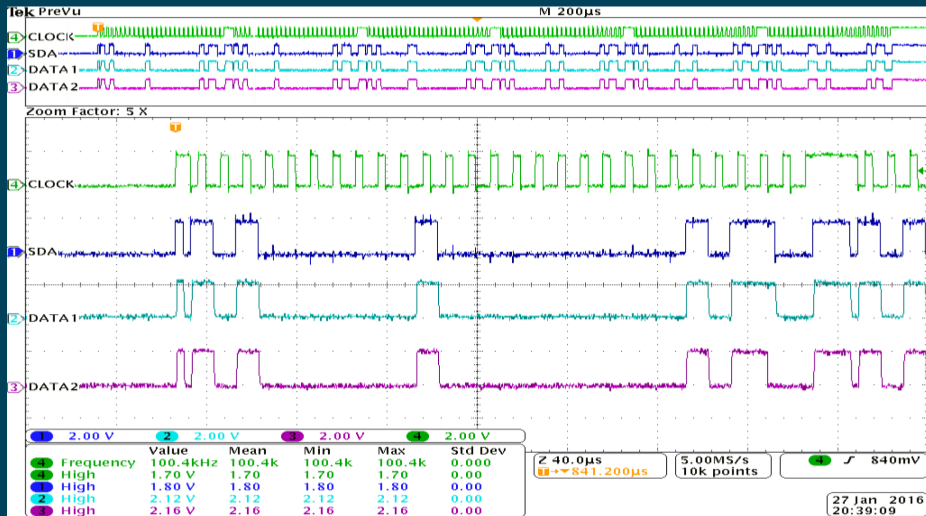
RESULT AND DISCUSSION

Supply current measurements after sending the 6 frames of data instructions during dynamic initialization. Supply current dropped significantly after all transmitter and receivers were disabled.

	Normal Operation	After disabling all Tx and Rx
Supply Current	283 mA	20mA

RESULT AND DISCUSSION

- Plot showing selected two DUT's SDA pin signal, DATA1 and DATA2 that are identical to SDA signal which is the data instruction from pattern resource. This means that intended data instruction to power down the device was properly accepted by all devices on the board.



RESULT AND DISCUSSION

Plot which shows that TPI signal or the device OP_A0 output of the selected DUT pulled up to VTTO. This is what expected on device output after sending the first data frame that is intended to disable it.

CONCLUSION

- Based on the data gathered from the experiment, this new burn-in board design approach is an effective solution that allows sending data instruction to all I2C devices on burn-in boards with just single SDA clock pattern resource.

RECOMMENDATION

- Ovens in ADI Rel Labs have different capability in terms of number of clock pattern resource available. Therefore, it is recommended to use this new design approach on burn-in boards as this will eliminate limitation on some ovens to run I2C devices.

REFERENCE

[1]Wikipedia – The Free Encyclopedia
https://en.wikipedia.org/wiki/I%C2%B2C

[2] AD8158 Datasheets
http://www.analog.com/media/en/technical-documentation/data-sheets/AD8158.pdf