
AVR600: STK600 Expansion, routing and socket boards

1 Introduction

This application note describes the process of developing new routing, socket and expansion cards for the STK[®]600. It also describes the physical parameters for creating such cards.

The STK600 starter kit from Atmel has a sandwich design to match a specific part package and pin out to the generic pin headers. It also features an expansion area where most part pins are available.

While the variety of IC packages is relatively limited, the number of possible pin outs increases rapidly with the number of pins. i.e. a 6 pin IC can have 720 (6!) different pin outs!

The routing / socket card design provides a low cost solution to support upcoming devices as the socket is the cost driving factor.

STK600 users might also want to create their own routing cards to include specialized hardware to prototype their design.

Figure 1-1. STK600 router and socket card



8-bit **AVR[®]**
Microcontrollers

Application Note

Rev. 8170A-AVR-08/08



2 Routing cards

The routing cards sit between the generic socket card and the STK600. It has one pair of electric pads underneath to mate with the STK600 spring loaded connector, and one pair of pads on top where the socket card connector connects. A part specific card with the target IC soldered on can be viewed as a routing card without the top pads.

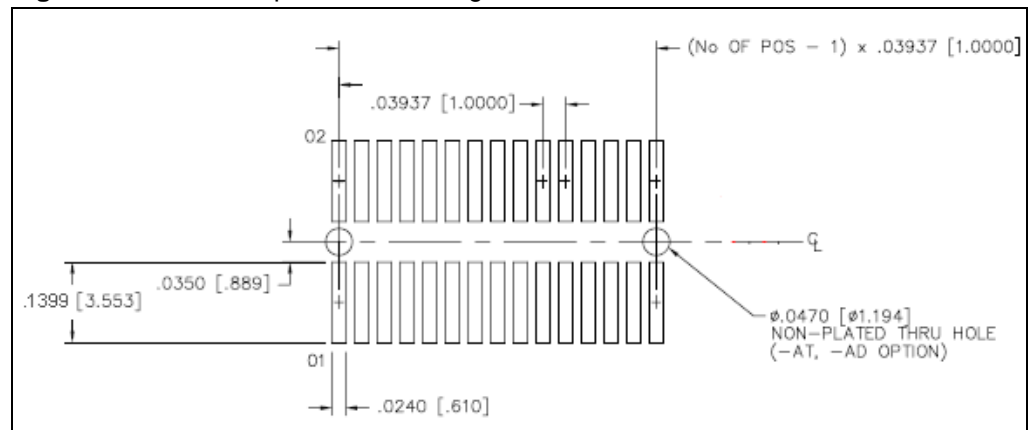
2.1 Connector footprints

A Routing card should have pads to mate with the following spring loaded connectors:

Table 2-1. Router card connectors

| Manufacturer and MPN | Quantity | Comment |
|---------------------------|----------|------------------------------|
| SAMTEC, FSI-140-03-G-D-AD | 2 | 80 pins To socket card (top) |
| SAMTEC, FSI-150-03-G-D-AD | 2 | 100 pins To STK600 (bottom) |

Figure 2-1. PCB land pattern for mating to FSI connectors



2.2 Physical dimensions and component placement

Figure 2-2. Routing card connector pad placement and dimensions

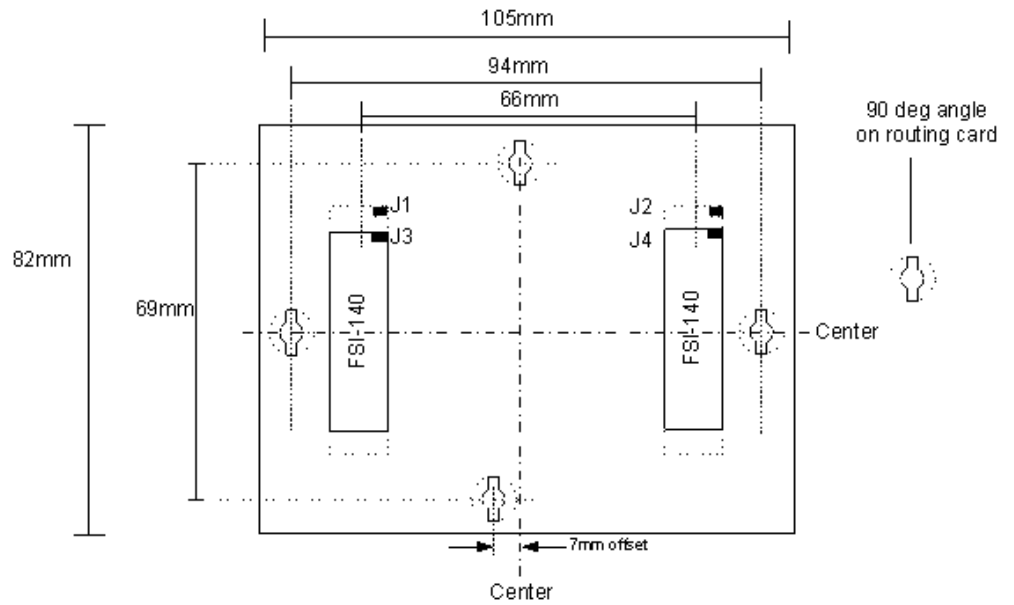
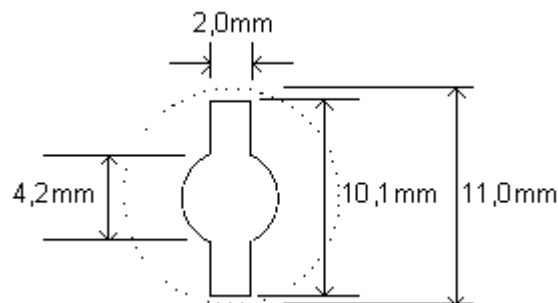


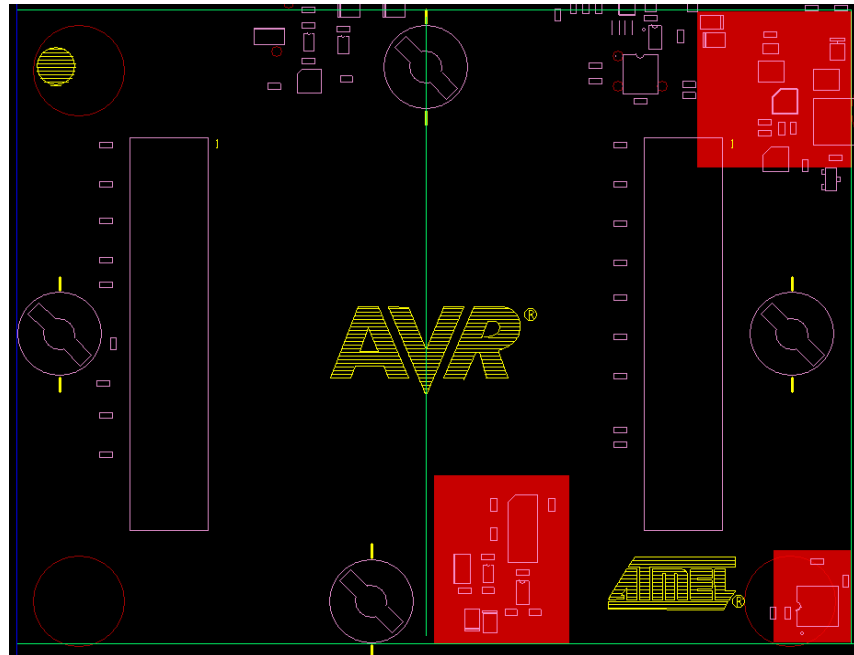
Figure 2-3. Clip hole dimensions



The board thickness should be 1.6mm to be compatible with the clips.

Note that components on the main board might conflict with through hole mounted or secondary side mounted components. Areas with such components are highlighted in the next figure

Figure 2-4. Height restricted areas due to main board components



2.3 STK600 socket connectors pinout

The following figure shows the pinout for the STK600 headers. This correspond to the routing card connectors J1 and J2

Figure 2-5. STK600 Socket connectors pin out

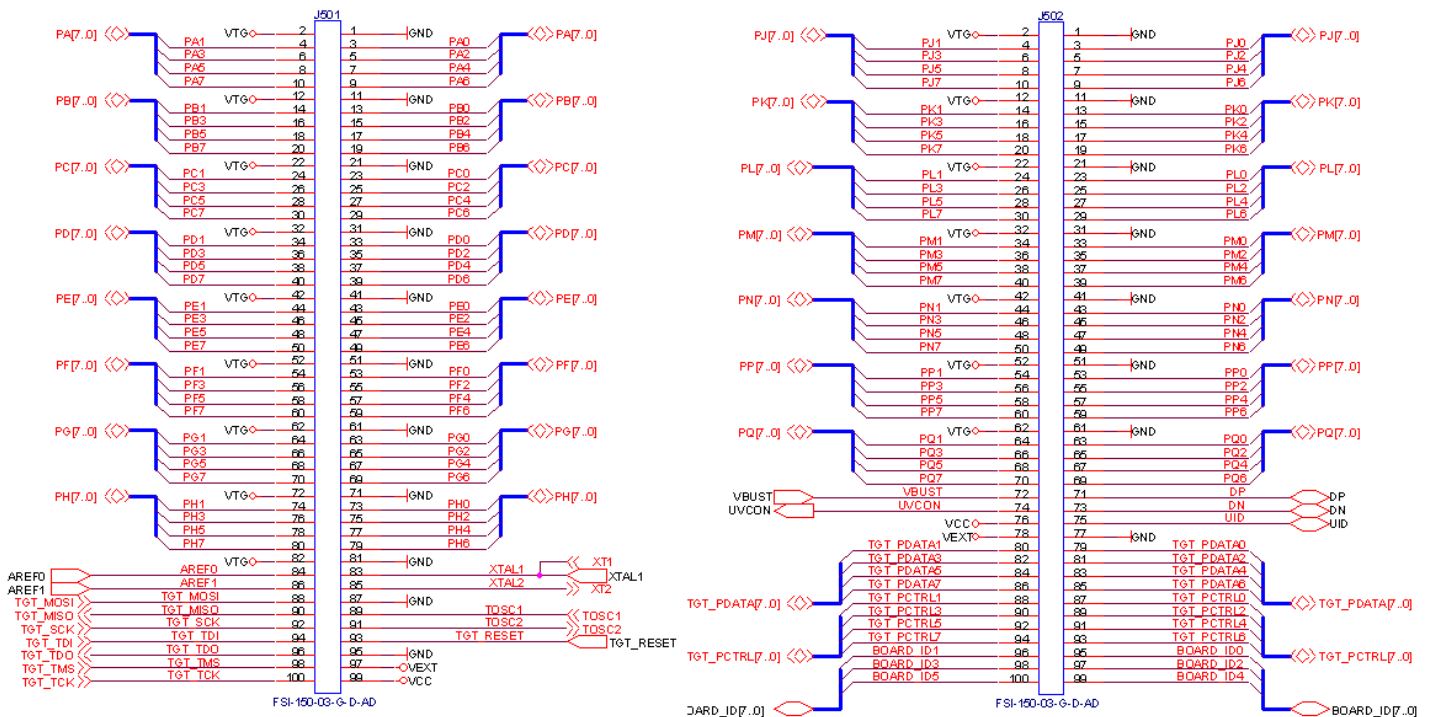


Table 2-2. STK600 J201 left, routing card J1 connector pin out

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| VTG | 2 | 1 | GND |
| PA1 | 4 | 3 | PA0 |
| PA3 | 6 | 5 | PA2 |
| PA5 | 8 | 7 | PA4 |
| PA7 | 10 | 9 | PA6 |
| VTG | 12 | 11 | GND |
| PB1 | 14 | 13 | PB0 |
| PB3 | 16 | 15 | PB2 |
| PB5 | 18 | 17 | PB4 |
| PB7 | 20 | 19 | PB6 |
| VTG | 22 | 21 | GND |
| PC1 | 24 | 23 | PC0 |
| PC3 | 26 | 25 | PC2 |
| PC5 | 28 | 27 | PC4 |
| PC7 | 30 | 29 | PC6 |
| VTG | 32 | 31 | GND |
| PD1 | 34 | 33 | PD0 |
| PD3 | 36 | 35 | PD2 |
| PD5 | 38 | 37 | PD4 |
| PD7 | 40 | 39 | PD6 |
| VTG | 42 | 41 | GND |
| PE1 | 44 | 43 | PE0 |
| PE3 | 46 | 45 | PE2 |
| PE5 | 48 | 47 | PE4 |
| PE7 | 50 | 49 | PE6 |
| VTG | 52 | 51 | GND |
| PF1 | 54 | 53 | PF0 |
| PF3 | 56 | 55 | PF2 |
| PF5 | 58 | 57 | PF4 |
| PF7 | 60 | 59 | PF6 |
| VTG | 62 | 61 | GND |
| PG1 | 64 | 63 | PG0 |
| PG3 | 66 | 65 | PG2 |
| PG5 | 68 | 67 | PG4 |
| PG7 | 70 | 69 | PG6 |
| VTG | 72 | 71 | GND |
| PH1 | 74 | 73 | PH0 |
| PH3 | 76 | 75 | PH2 |





| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| PH5 | 78 | 77 | PH4 |
| PH7 | 80 | 79 | PH6 |
| VTG | 82 | 81 | GND |
| AREF0 | 84 | 83 | XTAL1 |
| AREF1 | 86 | 85 | XTAL2 |
| TGT_MOSI | 88 | 87 | GND |
| TGT_MISO | 90 | 89 | TOSC1 |
| TGT_SCK | 92 | 91 | TOSC2 |
| TDI | 94 | 93 | TGT_RESET |
| TDO | 96 | 95 | GND |
| TMS | 98 | 97 | Vext |
| TCK | 100 | 99 | Vcc |

Table 2-3. STK600 J202 right, routing card connector J2 pin out

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| VTG | 2 | 1 | GND |
| PJ1 | 4 | 3 | PJ0 |
| PJ3 | 6 | 5 | PJ2 |
| PJ5 | 8 | 7 | PJ4 |
| PJ7 | 10 | 9 | PJ6 |
| VTG | 12 | 11 | GND |
| PK1 | 14 | 13 | PK0 |
| PK3 | 16 | 15 | PK2 |
| PK5 | 18 | 17 | PK4 |
| PK7 | 20 | 19 | PK6 |
| VTG | 22 | 21 | GND |
| PL1 | 24 | 23 | PL0 |
| PL3 | 26 | 25 | PL2 |
| PL5 | 28 | 27 | PL4 |
| PL7 | 30 | 29 | PL6 |
| VTG | 32 | 31 | GND |
| PM1 | 34 | 33 | PM0 |
| PM3 | 36 | 35 | PM2 |
| PM5 | 38 | 37 | PM4 |
| PM7 | 40 | 39 | PM6 |
| VTG | 42 | 41 | GND |
| PN1 | 44 | 43 | PN0 |
| PN3 | 46 | 45 | PN2 |
| PN5 | 48 | 47 | PN4 |

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| PN7 | 50 | 49 | PN6 |
| VTG | 52 | 51 | GND |
| PP1 | 54 | 53 | PP0 |
| PP3 | 56 | 55 | PP2 |
| PP5 | 58 | 57 | PP4 |
| PP7 | 60 | 59 | PP6 |
| VTG | 62 | 61 | GND |
| PQ1 | 64 | 63 | PQ0 |
| PQ3 | 66 | 65 | PQ2 |
| PQ5 | 68 | 67 | PQ4 |
| PQ7 | 70 | 69 | PQ6 |
| VBUST | 72 | 71 | DP |
| UVCON | 74 | 73 | DN |
| Vcc | 76 | 75 | UID |
| Vext | 78 | 77 | GND |
| TGT_PDATA1 | 80 | 79 | TGT_PDATA0 |
| TGT_PDATA3 | 82 | 81 | TGT_PDATA2 |
| TGT_PDATA5 | 84 | 83 | TGT_PDATA4 |
| TGT_PDATA7 | 86 | 85 | TGT_PDATA6 |
| TGT_PCTRL1 | 88 | 87 | TGT_PCTRL0 |
| TGT_PCTRL3 | 90 | 89 | TGT_PCTRL2 |
| TGT_PCTRL5 | 92 | 91 | TGT_PCTRL4 |
| TGT_PCTRL7 | 94 | 93 | TGT_PCTRL6 |
| BOARD_ID1 | 96 | 95 | BOARD_ID0 |
| BOARD_ID3 | 98 | 97 | BOARD_ID2 |
| BOARD_ID5 | 100 | 99 | BOARD_ID4 |

2.3.1 Signal descriptions

Table 2-4. Socket card connector pin description

| STK600 Signal name | MCU | Comment |
|--------------------|-------------------|---|
| PAx, PBx etc | PAx, PBx etc | 1-to-1 mcu pin mapping |
| VTG | Vcc | Target supply rail controlled by AVR Studio® / STK600 |
| GND | GND | |
| AREF _x | AREF | Analog reference voltage, controlled by AVR Studio / STK600 |
| XTAL _x | XTAL _x | Clock pins connected to oscillator on STK600. |





| STK600 Signal name | MCU | Comment |
|------------------------------------|--------------------|--|
| TGT_SCK, TGT_MISO, TGT_MOSI | ISP pins | ISP programming interface |
| TGT_TDI, TGT_TDO, TGT_TMS, TGT_TCK | JTAG pins | JTAG programming interface |
| VBUST | VBUS | VBUS (sense) for USB |
| UID | UID | ID pin for USB OTG |
| UVCON | UVCON | USB VBUS generation control for USB OTG. A low level on this signal enables VBUS generation. |
| DP, DN | DP, DN | USB differential pair |
| TGT_PDATAx | (HV) data pins | Data pins for high voltage (PP/HVSP) programming. |
| TGT_CTRL0 | (HV) Byte Select 2 | Control signals for High voltage Parallel Programming / Serial Programming. Please refer to AVR datasheet for further information. |
| TGT_CTRL1 | (HV) Ready | |
| TGT_CTRL2 | (HV) Output Enable | |
| TGT_CTRL3 | (HV) Write Enable | |
| TGT_CTRL4 | (HV) Byte Select 1 | |
| TGT_CTRL5 | (HV) XTAL0 | |
| TGT_CTRL6 | (HV) XTAL1 | |
| TGT_CTRL7 | (HV) PAGEL | |
| BOARD_IDn | none | ID system for router / socket / expansion cards, see section 5 - ID System |

- Notes:
1. Not all AVR will have every pin (ex. two aref pins, tosc or usb)
 2. A MCU pin will fan-out to both Pnx pin and to the programming interface(s) located at that pin.

3 Socket cards

Socket cards route each pin from the IC socket to separate pins on the spring loaded connectors on the bottom side, facing the routing card.

3.1 Power design issues

Since all routing is handled by the routing card, even power lines and power decoupling is ignored at the socket card. This produces less than ideal power design which may lead to unwanted noise, ground bounce and other effects. It should therefore be expected that heavily loaded designs can not run at full speed on STK600. Likewise, such power design is not recommended for custom designs.

3.2 Connector MPN

Table 3-1. Socket card connector

| Manufacturer and MPN | Quantity | Comment |
|---------------------------|----------|--------------------------------|
| SAMTEC, FSI-140-03-G-D-AD | 2 | Spring loaded 80-pin connector |

3.3 Physical dimensions and component placement

Figure 3-1. Socket card connector placement and dimensions
 Error! Not a valid link.

The board thickness should be 1.6mm to be compatible with the clips.

4 Expansion cards

The STK600 features an expansion area where cards for custom peripherals like memory expansion, LCD etc can be placed. STK600 routes all part pins and power to the expansion card connectors.

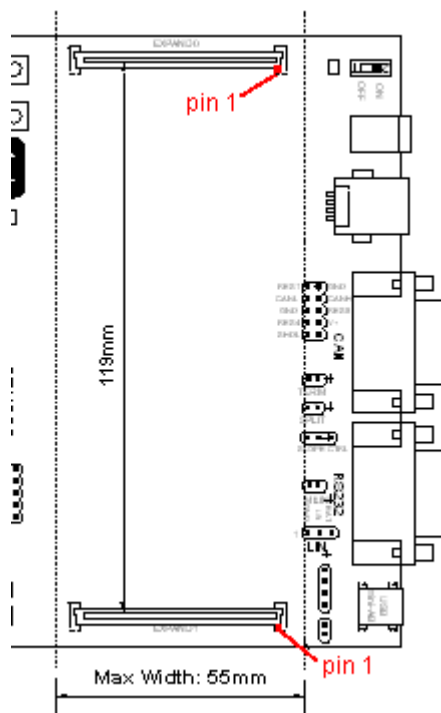
4.1 Connector MPN

Table 4-1. Expansion card connector

| Manufacturer and MPN | Quantity | Comment |
|----------------------|----------|---------|
| FCI, 61082-101402LF | 2 | |

4.2 Physical dimensions and component placement

Figure 4-1. Expansion card connector placement and dimensions



There is no requirement to board thickness.



4.3 STK600 Expansion connectors pin out

Figure 4-2. Pinout for expansion connectors

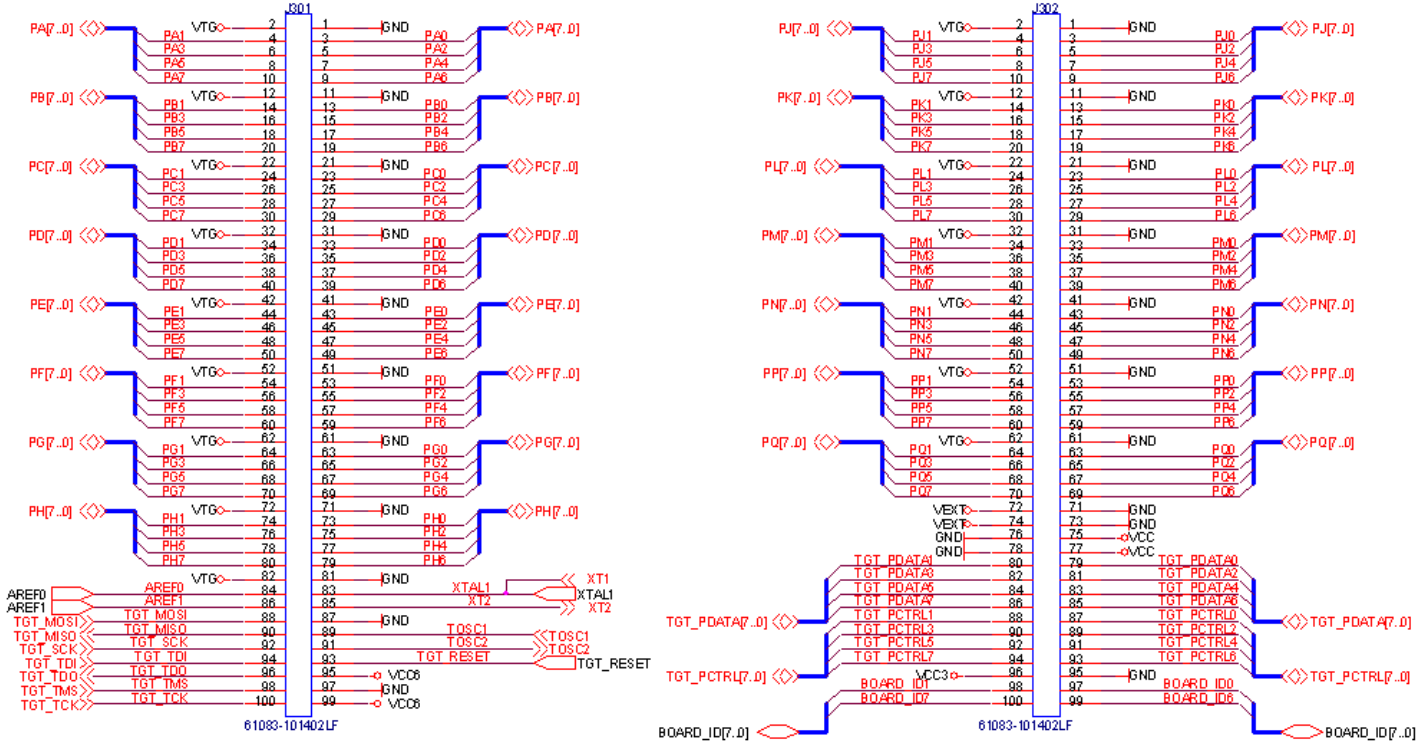


Table 4-2. STK600 J301 “expand0” connector pin out

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| VTG | 2 | 1 | GND |
| PA1 | 4 | 3 | PA0 |
| PA3 | 6 | 5 | PA2 |
| PA5 | 8 | 7 | PA4 |
| PA7 | 10 | 9 | PA6 |
| VTG | 12 | 11 | GND |
| PB1 | 14 | 13 | PB0 |
| PB3 | 16 | 15 | PB2 |
| PB5 | 18 | 17 | PB4 |
| PB7 | 20 | 19 | PB6 |
| VTG | 22 | 21 | GND |
| PC1 | 24 | 23 | PC0 |
| PC3 | 26 | 25 | PC2 |
| PC5 | 28 | 27 | PC4 |
| PC7 | 30 | 29 | PC6 |
| VTG | 32 | 31 | GND |

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| PD1 | 34 | 33 | PD0 |
| PD3 | 36 | 35 | PD2 |
| PD5 | 38 | 37 | PD4 |
| PD7 | 40 | 39 | PD6 |
| VTG | 42 | 41 | GND |
| PE1 | 44 | 43 | PE0 |
| PE3 | 46 | 45 | PE2 |
| PE5 | 48 | 47 | PE4 |
| PE7 | 50 | 49 | PE6 |
| VTG | 52 | 51 | GND |
| PF1 | 54 | 53 | PF0 |
| PF3 | 56 | 55 | PF2 |
| PF5 | 58 | 57 | PF4 |
| PF7 | 60 | 59 | PF6 |
| VTG | 62 | 61 | GND |
| PG1 | 64 | 63 | PG0 |
| PG3 | 66 | 65 | PG2 |
| PG5 | 68 | 67 | PG4 |
| PG7 | 70 | 69 | PG6 |
| VTG | 72 | 71 | GND |
| PH1 | 74 | 73 | PH0 |
| PH3 | 76 | 75 | PH2 |
| PH5 | 78 | 77 | PH4 |
| PH7 | 80 | 79 | PH6 |
| VTG | 82 | 81 | GND |
| AREF0 | 84 | 83 | XTAL1 |
| AREF1 | 86 | 85 | XTAL2 |
| TGT_MOSI | 88 | 87 | GND |
| TGT_MISO | 90 | 89 | TOSC1 |
| TGT_SCK | 92 | 91 | TOSC2 |
| TDI | 94 | 93 | TGT_RESET |
| TDO | 96 | 95 | Vcc6 |
| TMS | 98 | 97 | GND |
| TCK | 100 | 99 | Vcc6 |

Table 4-2. STK600 J302 “expand1” connector pinout

| Signal name | Pin number | | Signal name |
|-------------|------------|---|-------------|
| VTG | 2 | 1 | GND |
| PJ1 | 4 | 3 | PJ0 |





| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| PJ3 | 6 | 5 | PJ2 |
| PJ5 | 8 | 7 | PJ4 |
| PJ7 | 10 | 9 | PJ6 |
| VTG | 12 | 11 | GND |
| PK1 | 14 | 13 | PK0 |
| PK3 | 16 | 15 | PK2 |
| PK5 | 18 | 17 | PK4 |
| PK7 | 20 | 19 | PK6 |
| VTG | 22 | 21 | GND |
| PL1 | 24 | 23 | PL0 |
| PL3 | 26 | 25 | PL2 |
| PL5 | 28 | 27 | PL4 |
| PL7 | 30 | 29 | PL6 |
| VTG | 32 | 31 | GND |
| PM1 | 34 | 33 | PM0 |
| PM3 | 36 | 35 | PM2 |
| PM5 | 38 | 37 | PM4 |
| PM7 | 40 | 39 | PM6 |
| VTG | 42 | 41 | GND |
| PN1 | 44 | 43 | PN0 |
| PN3 | 46 | 45 | PN2 |
| PN5 | 48 | 47 | PN4 |
| PN7 | 50 | 49 | PN6 |
| VTG | 52 | 51 | GND |
| PP1 | 54 | 53 | PP0 |
| PP3 | 56 | 55 | PP2 |
| PP5 | 58 | 57 | PP4 |
| PP7 | 60 | 59 | PP6 |
| VTG | 62 | 61 | GND |
| PQ1 | 64 | 63 | PQ0 |
| PQ3 | 66 | 65 | PQ2 |
| PQ5 | 68 | 67 | PQ4 |
| PQ7 | 70 | 69 | PQ6 |
| Vext | 72 | 71 | GND |
| Vext | 74 | 73 | GND |
| GND | 76 | 75 | Vcc |
| GND | 78 | 77 | Vcc |
| TGT_PDATA1 | 80 | 79 | TGT_PDATA0 |
| TGT_PDATA3 | 82 | 81 | TGT_PDATA2 |

| Signal name | Pin number | | Signal name |
|-------------|------------|----|-------------|
| TGT_PDATA5 | 84 | 83 | TGT_PDATA4 |
| TGT_PDATA7 | 86 | 85 | TGT_PDATA6 |
| TGT_PCTRL1 | 88 | 87 | TGT_PCTRL0 |
| TGT_PCTRL3 | 90 | 89 | TGT_PCTRL2 |
| TGT_PCTRL5 | 92 | 91 | TGT_PCTRL4 |
| TGT_PCTRL7 | 94 | 93 | TGT_PCTRL6 |
| Vcc3 | 96 | 95 | GND |
| BOARD_ID1 | 98 | 97 | BOARD_ID0 |
| BOARD_ID7 | 100 | 99 | BOARD_ID6 |

5 ID System

The STK600 features an id system to identify which routing, socket and expansion card is attached. The STK600 can impose voltage limitations based on the IDs, and AVR Studio will notify the user if the combination is incorrect.

The ID system consists of two common output and two board unique input signals. Each input is one of sixteen possible values based in the input signals – giving a total id space of 256.

Three IDs are reserved for custom use and can be implemented without use of ICs.

Table 5-1. IDs reserved for custom use

| Type | ID | |
|------------------------|------|--|
| Board limited to 1.8 V | 0xCA | |
| Board limited to 3.3 V | 0xCC | |
| No limit on voltage | 0xCF | |

The id 0xff indicates no board present.

5.1 Signal usage

Table 5-2. ID system signal usage

| name | Direction | Function |
|-----------|------------|----------------------------|
| BOARD_ID0 | Output (a) | Common output to functions |
| BOARD_ID1 | Output (b) | Common output to functions |
| BOARD_ID2 | Input | Input from routing card |
| BOARD_ID3 | Input | Input from routing card |
| BOARD_ID4 | Input | Input from socket card |
| BOARD_ID5 | Input | Input from socket card |
| BOARD_ID6 | Input | Input from expansion card |
| BOARD_ID7 | Input | Input from expansion card |



5.2 ID functions

The functions and their output according to input A and B

| B | A | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Functions as logic expressions

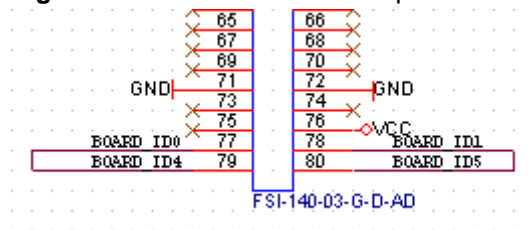
| Function | Expression | ID |
|----------|---------------------------------------|-----|
| 0 | 0 | 0x0 |
| 1 | $\overline{A + B}$ | 0x1 |
| 2 | \overline{AB} | 0x2 |
| 3 | \overline{B} | 0x3 |
| 4 | \overline{AB} | 0x4 |
| 5 | \overline{A} | 0x5 |
| 6 | $A \oplus B$ | 0x6 |
| 7 | \overline{AB} | 0x7 |
| 8 | AB | 0x8 |
| 9 | $\overline{A \oplus B}$ | 0x9 |
| 10 | A | 0xA |
| 11 | $\overline{B} + AB$ | 0xB |
| 12 | B | 0xC |
| 13 | $B + \overline{A} \cdot \overline{B}$ | 0xD |
| 14 | $A + B$ | 0xE |
| 15 | 1 | 0xF |

5.3 Examples

For a socket card to report the ID 0xCA:

Route BOARD_ID0 to BOARD_ID4 and BOARD_ID1 to BOARD_ID5

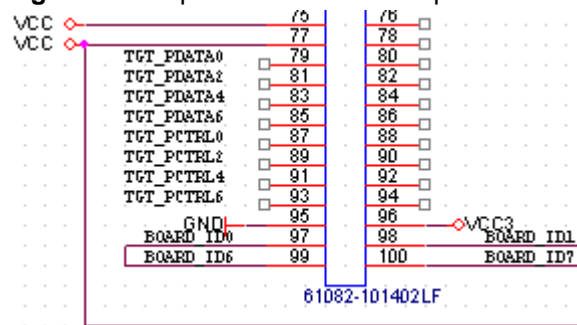
Figure 5-1. Socket card id example



For an expansion card to report the ID 0xCF:

Route BOARD_ID0 to BOARD_ID6 and VCC to BOARD_ID7

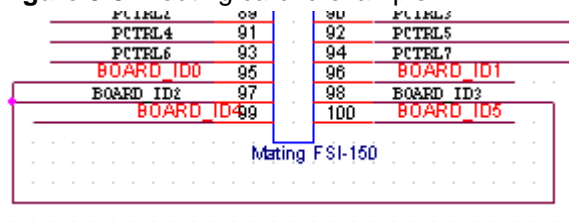
Figure 5-2. Expansion card id example



For a router card to report the ID 0xCC:

Route BOARD_ID0 to both BOARD_ID3 and BOARD_ID4.

Figure 5-3. Routing card id example



6 Design example

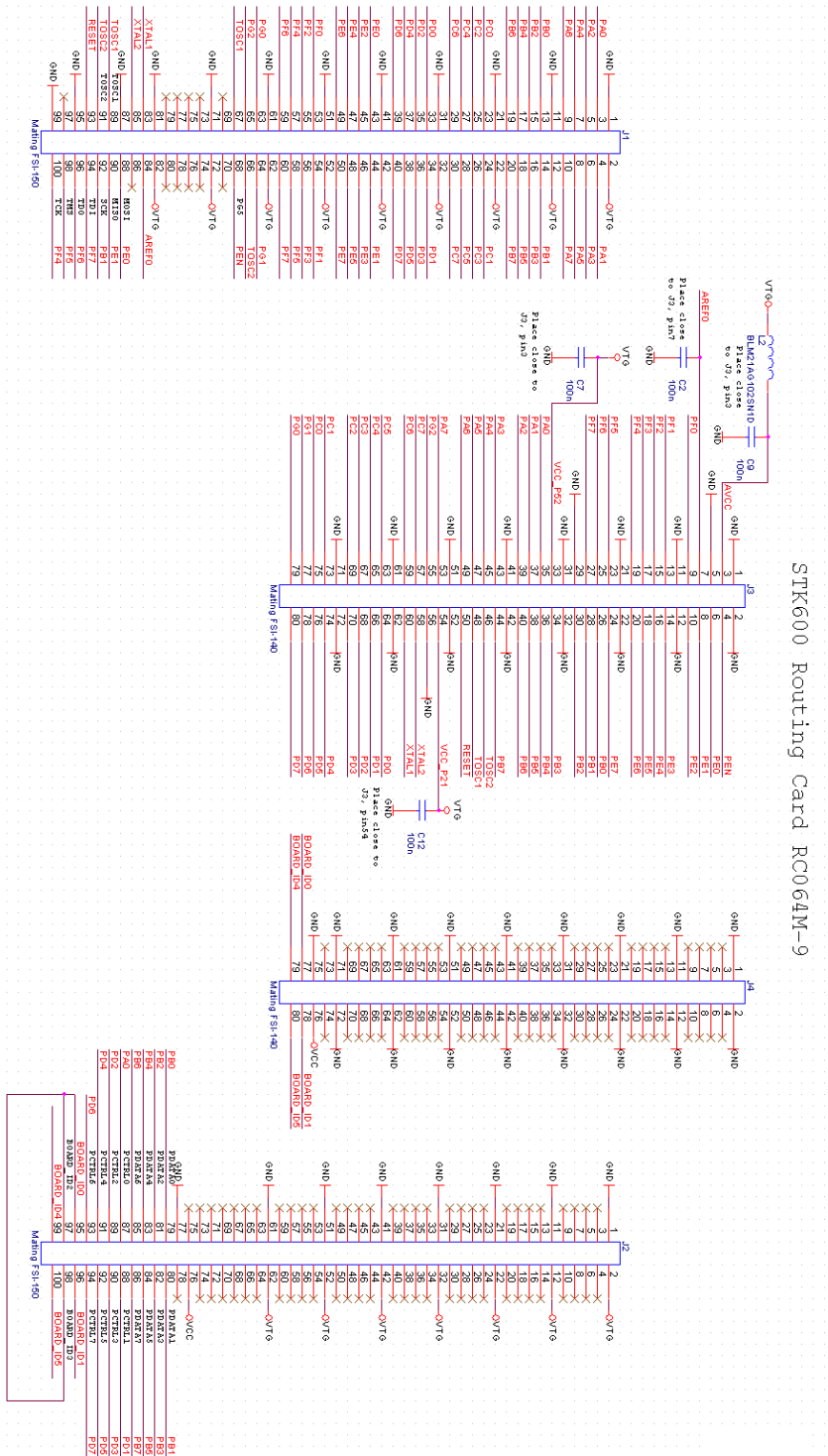
To support a new package type one would typically start with designing the socket card. The pinout between the socket card and routing card is not defined and left to the designer. An example is given in figure 6-1

Next is the design of the routing card (figure 6-3). The routing cards role is to connect each pin from the socket card to the corresponding pin on STK600. In addition to decoupling etc, the routing card should also fan-out the correct signals to programming headers.

Each card in the stack has its own board_id pins, the routing card is responsible for passing on the signal to the socket card.



Figure 6-3. Schema capture of routing card



Copyright © 2008, Atmel Corporation





Headquarters

Atmel Corporation
2325 Orchard Parkway
San Jose, CA 95131
USA
Tel: 1(408) 441-0311
Fax: 1(408) 487-2600

International

Atmel Asia
Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimshatsui
East Kowloon
Hong Kong
Tel: (852) 2721-9778
Fax: (852) 2722-1369

Atmel Europe
Le Krebs
8, Rue Jean-Pierre Timbaud
BP 309
78054 Saint-Quentin-en-
Yvelines Cedex
France
Tel: (33) 1-30-60-70-00
Fax: (33) 1-30-60-71-11

Atmel Japan
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
Tel: (81) 3-3523-3551
Fax: (81) 3-3523-7581

Product Contact

Web Site
www.atmel.com

Technical Support
avr@atmel.com

Sales Contact
www.atmel.com/contacts

Literature Request
www.atmel.com/literature

Disclaimer: The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© 2008 Atmel Corporation. All rights reserved. Atmel®, logo and combinations thereof, AVR®, AVR Studio®, STK® and others, are the registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.