

Half-mini PCI Card

Insight SiP was requested by a 3G solutions enabler to miniaturize an existing PCI Express Card and make it fit in a half-mini card form factor fully functional.

The goal is to design a half-mini PCI Express card, sized 26.8mm x 30mm. It is a 2-side wireless module that includes:

- Modem and memory assembled as a POP (Package-on-Package)
- Power management IC
- Transceiver with diversity
- TCXO
- 7-band W-CDMA/EDGE radio (PMB 6952) with RX diversity for WCDMA bands
- W-CDMA PA modules
- GSM PA module
- Antenna switch plexer with associated matching circuits
- RF decoupling

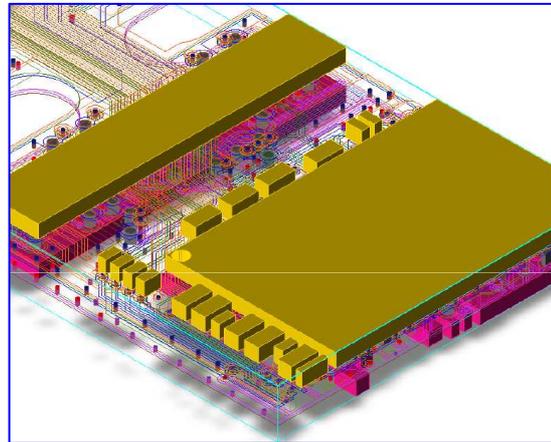
A metal RF shield is employed on both sides of the module.

The half mini-card should support all cellular standards - HSPA, W-CDMA, EDGE and GSM - and can be integrated into portable consumer electronic devices that need mobile connectivity technology.

Application:

Mobile Internet Devices, Ultra Mobile PC such as :

- netbooks,
 - notebooks,
 - fixed-wireless terminals,
 - personal navigation devices,
 - tablets,
 - cameras,
 - e-book readers,
- any portable consumer devices



After the feasibility study Insight SiP's team implemented a process to design this complex RF module.

The process is divided in 4 successive phases:

- Preliminary analysis to understand the requirements before design phase starts
- Design
- Prototype Manufacturing
- Test & Analysis

This case study describes the detailed design process flow and how it contributed to successfully get at the first pass prototyping a working half-mini card.

Preliminary Analysis

During the preliminary analysis, the critical components in the reference design including the PAs, the switch plexer and the transceiver module are analyzed. Different topological solutions for the RF part of the module were evaluated and preliminary routing was provided. Different ways of integrating the passive functions were compared including IPD and SMT on substrate based approaches. An analysis of the shielding methodology was also performed at this point. Particular attention was given to the frontier between the RF part of the module and the digital baseband part.

Design

This design phase is articulated around 3 main steps.

- First step: the module design and its integration on the substrate are completed. In

the meantime the routing strategy analysis is completed and implemented.

At this stage of the design process the layout strategy is defined and the board stack-up is confirmed. The initial simulations are carried out to examine the grounding and decoupling scenario to minimize coupling within the module.

Once the layout strategy is confirmed, the revised schematic for the laminate is created and validated.

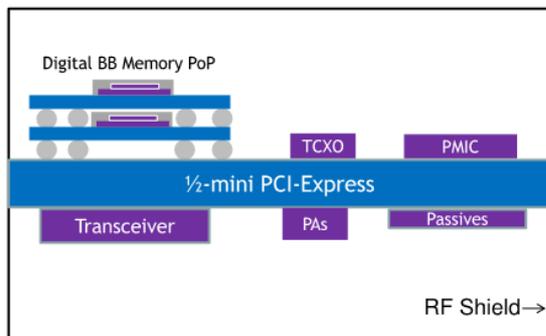
- During the second step of the design phase the PCB footprints for SMTs is created and validated within ADS to eliminate any possible discrepancies.

Then the analysis of the RF matching and coupling of portions of the design is performed with the EM simulations.

The RF to Baseband coupling and RF to DC coupling are simulated.

At this point, the laminate layout is ready for tapeout.

- During the third step the fabrication files are completed and delivered to the manufacturing partners selected to initiate prototype fabrication.



Prototype manufacturing & test strategy

The board manufacturing is launched.

For this specific design the test strategy involved both end-to-end system level testing as well as detailed baseband and RF specific testing. All tests are performed at room temperature and in three channels for each 2G/3G transmit and receive band.

Prototype Analysis

This last phase covers the detailed analysis of the results obtained with the prototypes. A review of the design and the specifications are done in order to achieve full compliance at the

end of the next design run. Finally further electromagnetic simulations were completed to optimize performance and fully meet the requirement specifications.

The half mini PCI card prototype delivered was fully functional; GSM and 3G trial phone calls were successfully achieved. The module was FCC pre-certified.

It is the proof of the excellent work done by Insight SiP's team to complete this complex design.

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