Duisburg-Essen University
Faculty of Engineering
Department of Electrical Engineering
and Information Technology
Institute of Microwave and RF Technology
300 MHz IQ-Demodulator for 7-Tesla MRI Smart Amplifier

Presented by: Khalid Zain Elabdin
Supervised by: Prof. Dr.-Ing. Klaus Solbach
Introduction

- Task assignment
- 7-Tesla MRI
- I/Q-demodulator
- Circuit design
- Test and results
- Conclusion
Assignment

to design a printed circuit for the I/Q-demodulator using the ICs and other surface-mount device (SMD) components and using microstrip line on a dielectric laminate as the printed circuit technology and using SubMiniature version A SMA coaxial connectors for signal input and output.
7-Tesla MRI
The System

Smart Power Amplifier (PA)

\( P_{in} \)

1. Power Divider
2. AD 8345 I/Q Modulator
3. MAX 2470
4. Filter
5. MRF6V 2010
6. MRF6 VP41
7. 1kW
8. \( \lambda/4 \)
9. N-\( \lambda/4 \)
10. Cable

11. Power Splitter
12. ADL 5391 Multiplier
13. Max 2470
14. Max 2055
15. AD8132
16. I/Q Demodulator
17. I/Q-Compensation Network
18. OP-Amp
19. 600 MHz
20. DAT 31R5
21. DIP-Switch
22. 2
23. DIP-Switch
24. AD 8309 Limiting Amp
25. \( \tau \)
26. Delay Line

UNIVERSITÄT
DUISBURG
ESSEN
I Q Demodulator

- HMC597LP4
- HIGH LINEARITY
- Low noise figure
AD8132 Differential amplifier
- Low cost – High speed
- Internal common-mode feedback
Final Schematic Design
Printed Circuit Board
Test Measurement and Results
Input Matching
Measurement Setup
Common Mode Rejection Ratio
Output Power RF
RF Gain Measurement

![RF Gain Measurement Graph](image)
Output Power LO

\[ P_{1dB} = -11.4 \]

\[ P_{out\ dBm} \]

\[ P_{LO, \ dBm} \]

-50 -40 -30 -27.7 -20 -10 0
Quadrature Accuracy

$\Delta \phi = 86.4^\circ$
Baseband Bandwidth

Normalized Amplitude, dB vs. $f_{RF} - f_{LO}$, MHz
Conclusion

- An I Q Demodulator was designed for the 7 tesla
- The layout was designed by eagle
- The RF gain -11.3 dBm
- The baseband bandwidth 17 MHz
- The 1 dB compression point 12.3 dBm