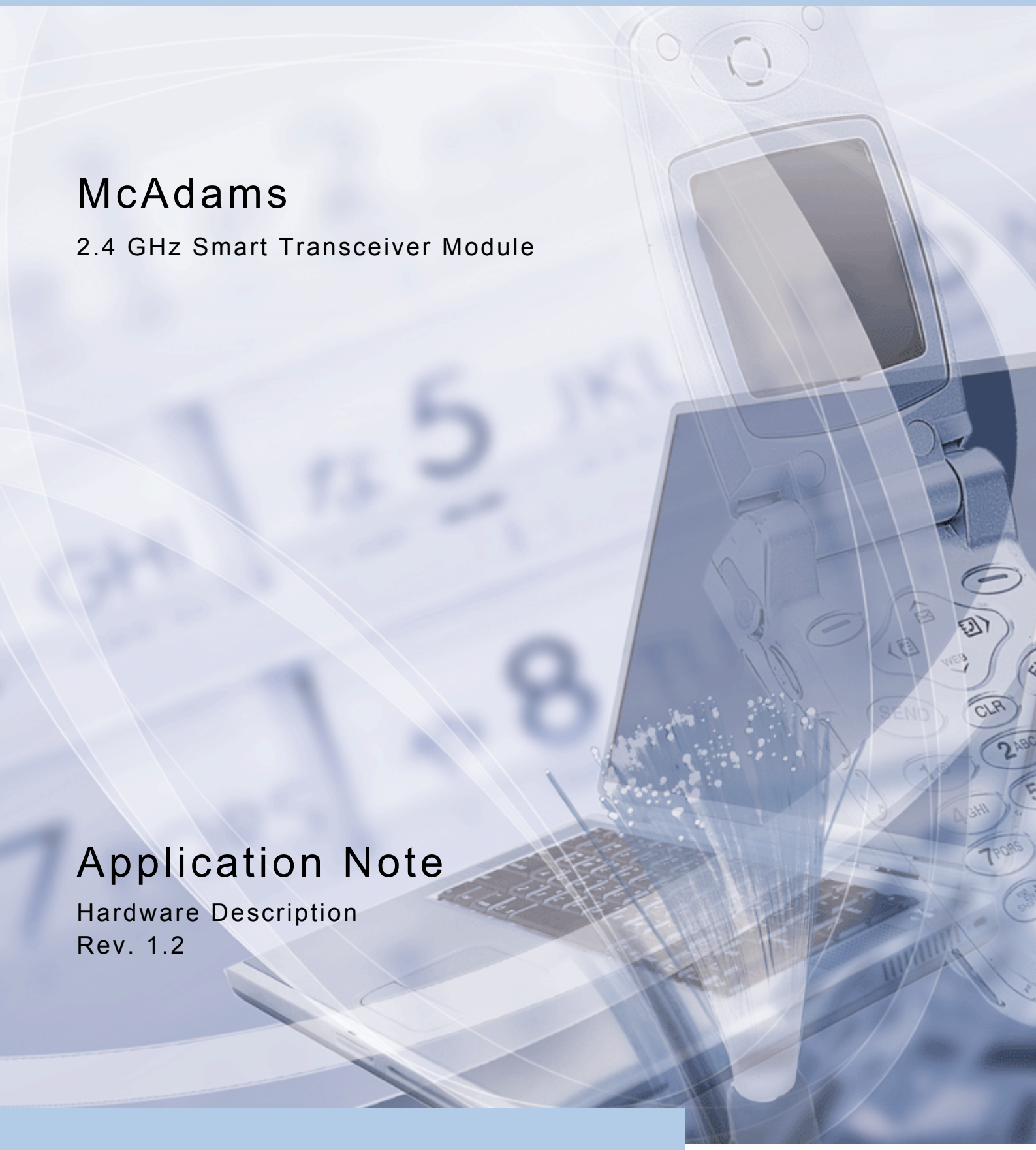
November 2008

McAdams

2.4 GHz Smart Transceiver Module



Application Note

Hardware Description
Rev. 1.2

Automotive, Industrial & Multimarket

Never stop thinking

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Infineon RFT v2.0
MAB-X816483-004

FCC ID: WFO-ADAMRFMO

IC: 6850B-ADAMRFMO

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Declaration of Conformity

Company Information: Infineon technologies
Am Campeon 1-12
85579 Neubiberg

Germany

Declares that the product: Mc Adams RF Module
MAB-X816483-004

Conforms to the following directives :

1999/5/EC	(R&TTE)
2004/108/EC	(EMC) and
2006/95/EC	(LVD)

and meets these essential standards:

SAFETY:	EN60950-1: 2005 (2nd edition) and/or EN60950-1:2006
EMC:	EN 301489-1 V1.6.1 and EN 301489-17: V1.2.1
Spectrum use:	EN300 328 V1.7.1

Munich 30.10.2008

(Dr.-Ing. Jörg Schönfeld)

DeclarationOfConformity.vsd

Figure 1 Declaration of Conformity

McAdams 2.4 GHz Smart Transceiver Module

Revision History: 2008-11-13, Rev. 1.2

Previous Version: 1.0	
Page	**Subjects (major changes since last revision)**
	Table 1, Table 3, Table 5, Table 6, Figure 3 updated.
Previous Version: 1.1	
	Figure 2 added
	Table 1, Figure 1, Figure 2, Figure 4, Figure 5 and layout guidelines updated

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1 2.4 GHz Smart Transceiver Module

This Application Note provides guidelines, hints, requirements and electrical specifications to enable customer to design in the 2.4 GHz Smart Transceiver module “Mc Adams” in wireless XBOX applications.

1.1 Overview

The 2.4 GHz Smart Transceiver module is intended to be used as a main building block in wireless XBOX peripheral systems. It can be easily connected to the host board. Communication between a backend processor and the module is done via a serial peripheral interface (SPI). The module top view is given in **Figure 2** .

2.4GHz Smart Transceiver Module2.vsd

Figure 2 Top View of the 2.4GHz Smart Transceiver Module

The Mc Adams RF module comprises a 2.4 GHz Smart Transceiver IC that is supported by a 12 MHz crystal oscillator and a security device, needed for authorization as an XBOX conform peripheral. The RF output is connected via a matching circuit (discrete balun) to a printed inverted F-antenna.

Note: Applications including the Mc Adams RF module must have an exterior label showing the information below:
“ Contains FCC ID:WFO-ADAMRFMO “

Furthermore it features module pins at the edges of the PCB which are described in **Table 1**.

Table 1 Module Pin Description

Pin	Name	Type	Function
X1	VSSA	GND	analog GND
X2	VSSIO	GND	digital GND

Table 1 Module Pin Description (cont'd)

Pin	Name	Type	Function
X3	VSSIO	GND	digital GND (module extra GND pin)
X4	VDDIOSEC	GND	IO Supply for security device
X5	CLKOUT	O	12 MHz clock or SysClk output for backend *Note: Voltage range of the microcontroller clock input needs to be checked against output voltage on CLKOUT. If it doesn't fit a level shifter needs to be added on the host board.*
X6, X7	VSSIO	GND	digital GND (module extra GND pins)
X8..X10	VSSA	GND	analog GND (module extra GND pins)
X11	WAKEUP_1#	I	Wakeup, external 1.5k pull up resistor to VDDIO needed on host board, active low
X12, X13	VDDIO	Supply	IO Supply
X14	GPIO(3)	IO	General Purpose IO
X15	GPIO(4)	IO	General Purpose IO
X16	D_AVAIL#	O	SPI slave data available
X17	GPIO(2)	IO	General Purpose IO or FRAME_SYNC#
X18	CS#	I	SPI chip select
X19	MOSI	I	SPI master output slave input signal
X20	MISO	O	SPI master input slave output signal
X21	WAKEUP_0#	I	Wakeup, external 1.5k pull up resistor to VDDIO needed on host board, active low
X22	CLK	I	SPI clock
X23	RESET#	I	Reset, external 1.5k pull up resistor to VDDIO needed on host board
X24	VDDCREG	S	VDDC regulator output
X25..X32	VSSA	GND	analog GND (module extra GND pins)

Symbols:

- I: Input
- O: Output
- S: Supply

1.2 Reference Schematic and Layout Guidelines

Layout guidelines

Some generic layout guidelines and parameters for the application host board are desribed below:

- Material recommendation: epoxy glass, nema grade FR4, halogen free ROHS and WEE compliant, rating 110-150 °C
- Place the McAdams module in a way that the antenna is not in the middle of the application PCB but at the edge
- Place ground plane under the Mc Adams module for shielding. Take particular note that there is no ground plane, trace or something similar below the antenna area to avoid RF signal disturbances.
- If possible leave a hole below the antenna area

In order to minimize crosstalk at the Mc Adams module a decoupling circuit for its power supply (VDDIO) should be placed on the host PCB. A simple decoupling circuit with a ferrite choke and three capacitors is shown in **Figure 3**.

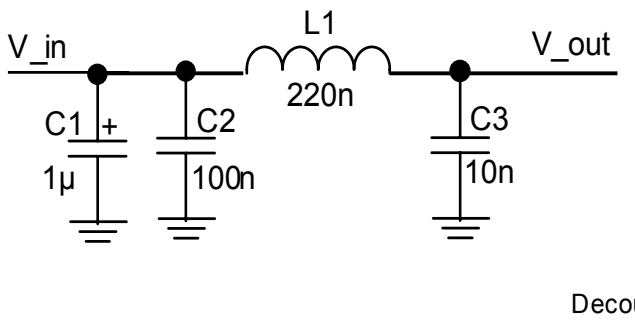
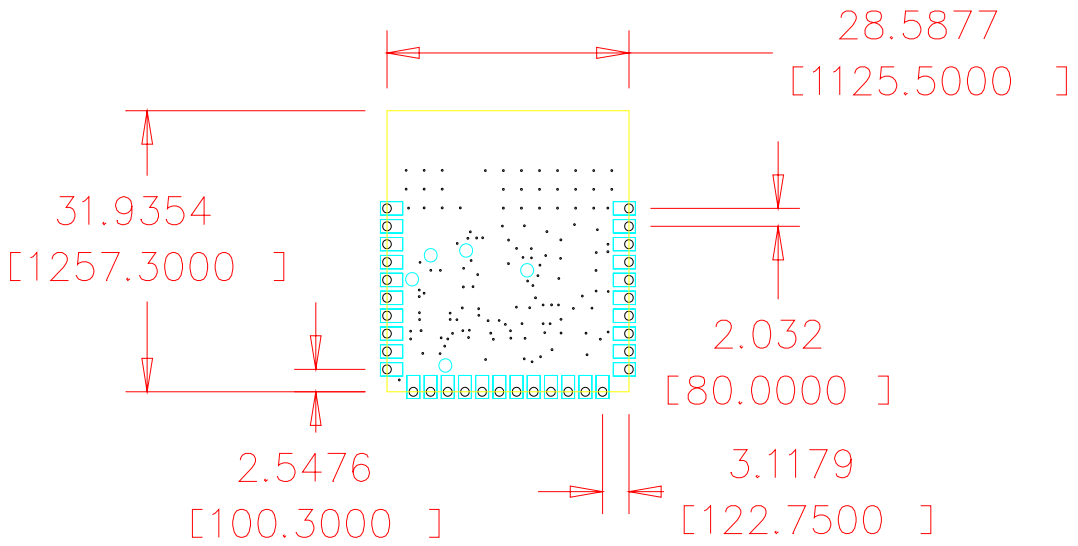


Figure 3 Decoupling Circuit

The Mc Adams Module has to be soldered onto the host board. The appropriate footprint for the host board is shown in **Figure 4**.

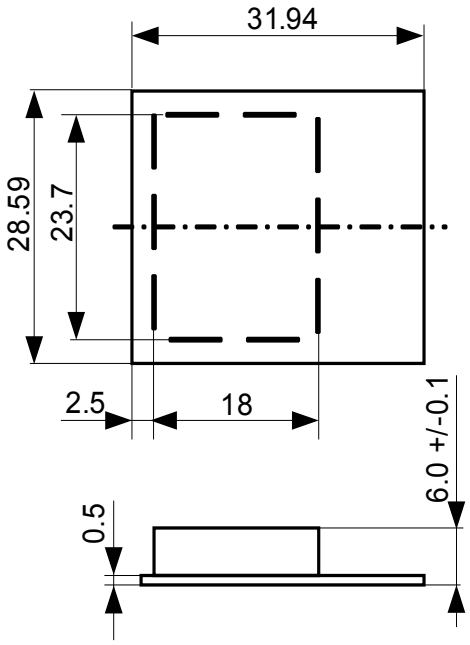


Note: dimensions in mm [mil]

2.4GHz Smart Transceiver Module Footprint.vsd

Figure 4 Footprint on Host Board for Mc Adams Module

The module drawing is illustrated in **Figure 5**.



Note: dimensions in mm

2.4GHz Smart Transceiver Module Drawing.vsd

Figure 5 Module Drawing

2 Electrical Specifications

2.1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings

Description	Min	Typ	Max	Units
Storage Temperature	-55		+150	°C
I/O Supply Voltage	-0.9		4.0	V
Input Voltage Range	-0.9		4.0	°C
Output Voltage Range	-0.9		4.0	°C
Lead Temp. (solder 4 sec)			+260	°C
RF core Power Supply Voltage	-0.3		1.9	V
Absolute difference between power supplies			0.3	V
Voltage on any pin			Vdd+0.3V	V
Storage Temperature			+150	°C
Lead Temp. (solder 4 sec)			+260	°C
ESD - human body model			2	KV
ESD - machine model			200	V

Attention: Stresses above those listed here are likely to cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. Maximum ratings are not operating conditions.

2.2 Operating Conditions

Table 3 Normal Operating Conditions

Description	Min.	Typ.	Max.	Units
Normal Operating ambient temperature range	5		+60	°C
Refer to CMOS digital input (35 ppm overall)		12		MHz
Input Supply Voltage VDDIO	2.0		3.6	V
I/0 Voltgage	2.0		3.6	V

2.3 Radio Specifications

Table 4 DC Supply Power Up Current

Description	Condition	Min.	Typ.	Max.	Units
Static current in power down	After reset and tbd			10	µA
Receive mode current with PLL synthesizer switch on	-90 dBm sensitivity		15		mA
Transmit mode current	High output power		15		mA
RF setup mode current	Tbd programmed		17		mA
Max. RF current	Including RF output current of the PA stage;		72		mA

Table 5 RF Receiver RFIO Port1

Description	Condition	Min.	Typ.	Max.	Units
Receiver input frequency range RFIO1/RFIO1X		2401		2483	MHz
LNA Input resistance (balanced)	f = 2440 MHz		100		Ohm
LNA Input capacitance	f = 2440 MHz		1		pF
LO leakage				-60	dBm
Low RSSI limit				-88	dBm
High RSSI limit		-48			dBm
RSSI resolution	4-bit		3		dB
Receiver sensitivity	BER <=1E-3; Ta=25°C	-92	-90		dBm
Receiver sensitivity degrade by full temperature range	BER <=1E-3; 0°C<=Ta<=+65°C		2		dBm
Receiver sensitivity, degraded by frequency offset	frequency offset|<= ±50Hz; Ta= 25°C		1.5	3	dBm
Receiver input power range	Ta = 25°C	-92		10	dBm
Intermodulation performance level (IP3)	Ta=25°C; BER <= 1E-3; RF wanted f= 2442 MHz, Pin = -70 dBm, FSK @2438 MHz, CW @2440 MHz	-27	-18		dBm
Interferer performance in high sensitivity mode; RF wanted f=2442 MHz, Pin = -70dBm, Ta=25°C, f=(2442+k+2)MHz	k = 0 (Co-channel) k = +/-1 k = +/-2 k =+/-3		10 -23 -50 -55		dBc dBc dBc dBc
Out of band blocking	1-2000 MHz 2000 - 2400 MHz 2484 - 6000 MHz		-30 -20 -20		dBm

Table 6 RF Transmitter RFIO Port1

Description	Condition	Min.	Typ.	Max.	Units
Transmitter output frequency range		2401		2483	MHz
Output power (high gain)			4		dBm
Output power (low gain)		-41	-38	-37	dBm
Coarse output power steps	Tx power control bits: 00000 --> 10000		25		dBm
Fine output power steps	Tx power control bits: 00000 + 1	1	2	4	dBm
Adjacent channel noise power (P/N)	P/N = +/-1 P/N = +/-2 P/N = +/-3		-36 -65 -68		dBc dBc dBc
Spurious Emission conducted device operation	30 MHz to 1 GHz 1.0 GHZ to 12,75 GHz 1.8 GHz to 1.9 GHz 5.15 GHz to 5.30 GHz		-60 -40 -60 -75		dBm dBm dBm dBm

2.4 SPI Timing

Table 7 SPI Timing Characteristics

Parameter	Limit Values			Unit	Test Condition
	Min.	Typ.	Max.		
f_{SPI} 1)			7.518	MHz	f_{sys} = 24 MHz
t_1	200			ns	
t_2	100			ns	
t_3	100			ns	
t_{out_delay}			20	ns	
t_{setup}	5			ns	

1) SPI frequency can be calculated by $f_{SPI} = f_{sys} / (3 + 8ns * f_{sys})$

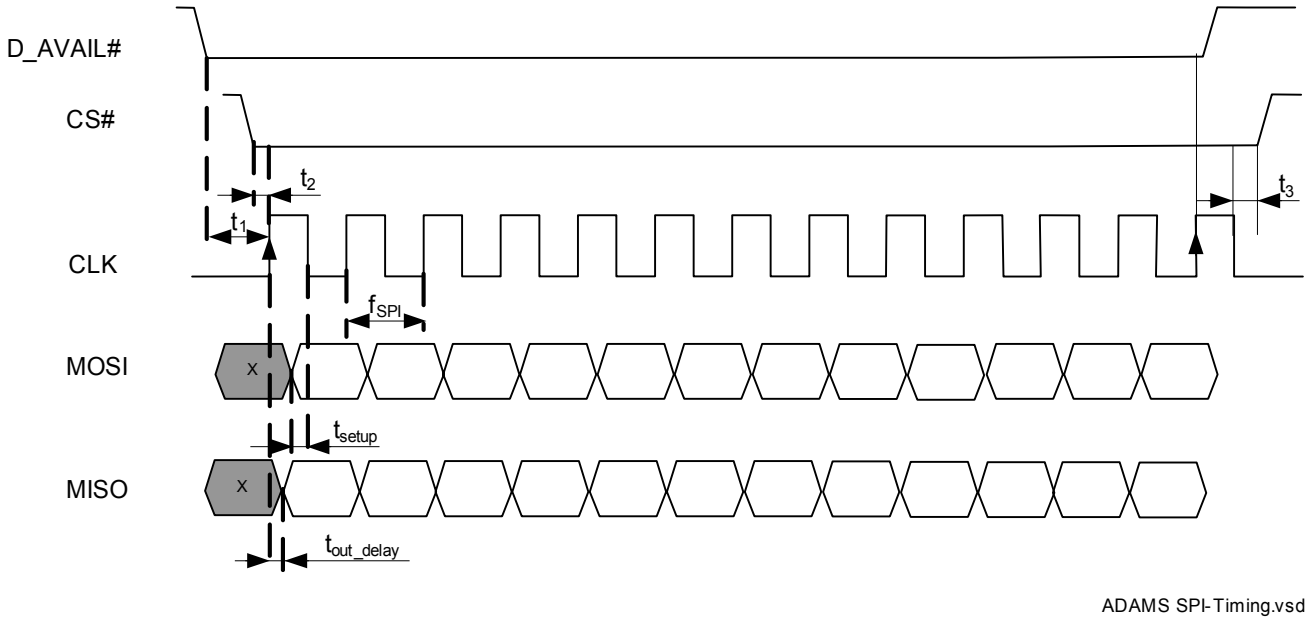


Figure 6 SPI Timing Diagram

Terminology

SPI	Serial Peripheral Interface

References

[1] Adams Smart Transceiver Data Sheet Rev. 1.1

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