TMS3705A - Transponder Base Station IC
Technical Presentation

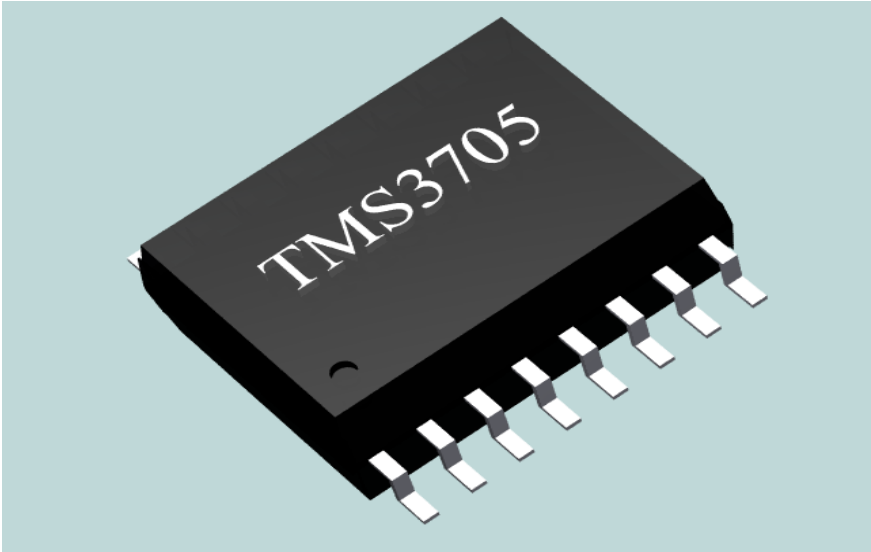
TMS3705A

General Features

- 5V device
- Automatic sleep mode after TXCT idle for 100ms (typ. 15, max. 200uA)
- Transponder resonance frequency measurement
- Internal Full Bridge Antenna Driver
- Digital Demodulator
- Diagnosis Function
- Several operating modes
  - self adapting or fixed resonance frequency for charge-up
  - automatic or fixed demodulator threshold
  - asynchronous and synchronous data transmission to uC
- Minimum amount of external components
- PLL for internal Clock generation
- 2/4 MHz Crystal or low cost Ceramic Resonator can be used

Package

- 16pin SO



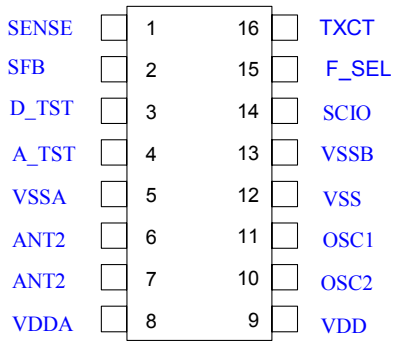
Documents

- TMS3705A Data Sheet
- Application Note [11-07-26-001 May 2001]
- DST Reference Manual [11-09-21-029 Dec. 1998]
- DST/TMS37192 TRP Sequence Control Specification [24-06-05-005 Jun. 1996]
- DST TRP Algorithm & SW Requirements
- Immobilizer Systems Designs Guide [Rev.01 Jan. 1996]
- Tricks and Hints for System Evaluation [Ver.2.0 Sept 1999]

Pin Names and Functions

Pin	Name		Function
1	SENSE	I	Input of the RF amplifier
2	SFB	O	Output of the RF amplifier
3	D_TST	O	Test output for digital signals
4	A_TST	O	Test output for analog signals
5	ANT1	O	Antenna output 1
6	VSSA	I	Ground for the full bridge drivers
7	ANT2	O	Antenna output 2
8	VDDA	I	Voltage supply for the full bridge drivers
9	VDD	I	Voltage supply for non – power blocks
10	OSC2	O	Oscillator output
11	OSC1	I	Oscillator input
12	VSS	I	Ground for non-power blocks
13	VSSB	I	Ground for PLL
14	SCIO	O	Data output to the Micro Controller
15	F_SEL	I	Control input for frequency selection (default High - M=8)
16	TXCT	I	Control input from the Micro Controller

D Package
(Top View)



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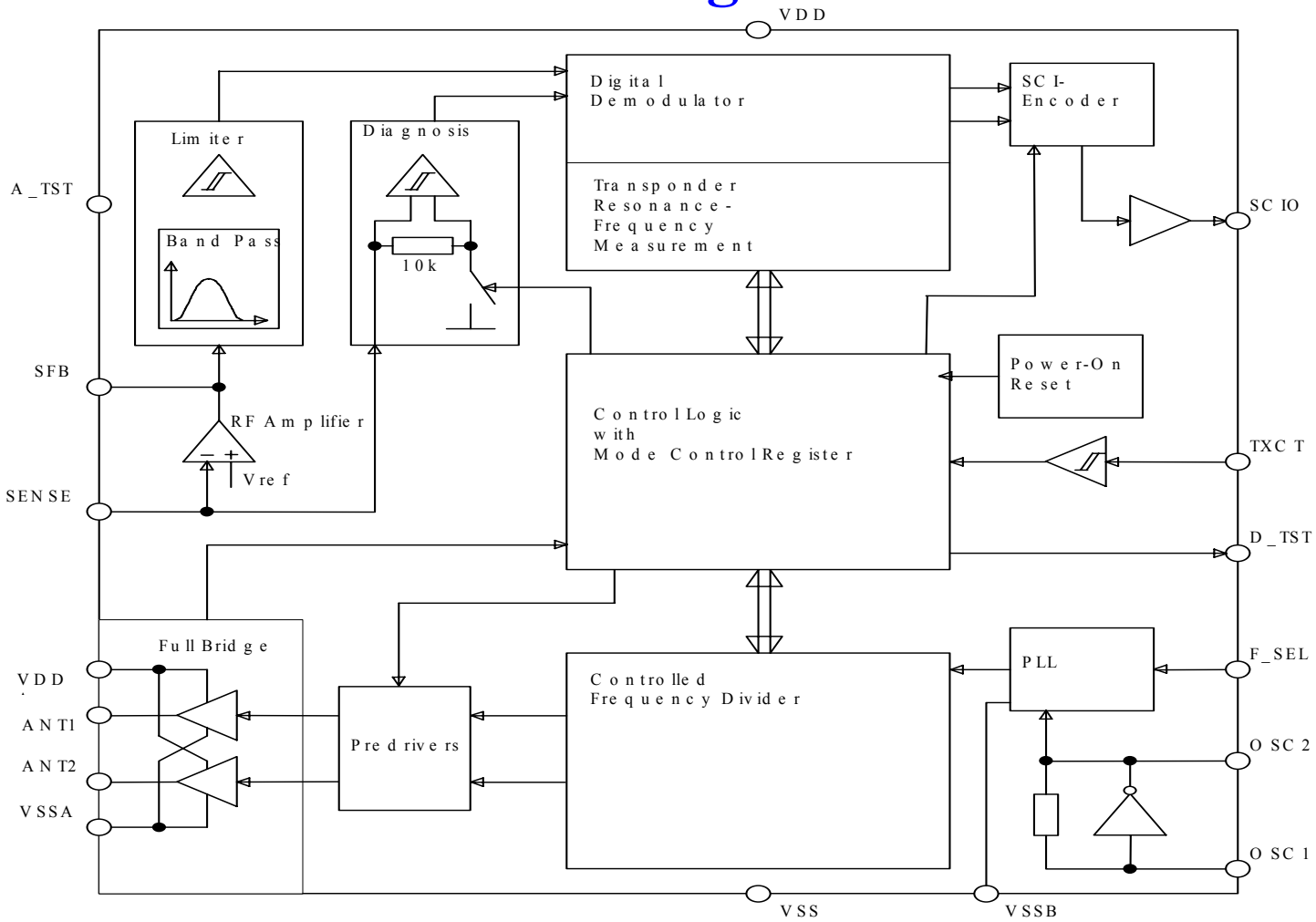
Block Diagram



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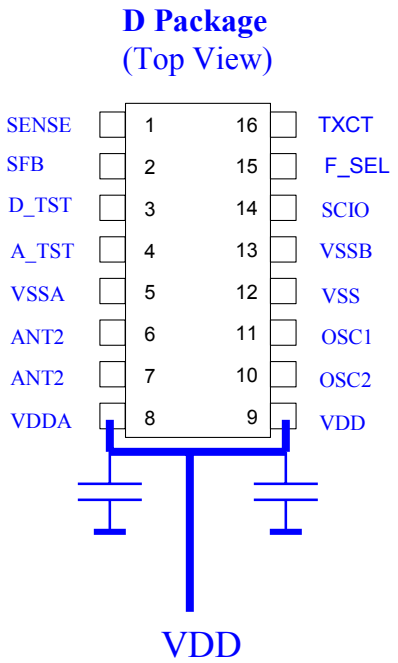
Supply Voltage and Block Capacitor

- In order to avoid uncontrolled radiation it is recommended to connect the Supply Voltage symmetrically to VDDA and VDD.
- As close as possible a single Blocking Capacitors should be connected to each of the supply pins.
- In addition a tantalum capacitor is recommended.



Diagnostic Byte

- The Diagnostic byte is sent 2ms after beginning of the charge phase
- Normal operation of the antenna . 0xAF
- If no antenna oscillation can be measured or short detection 0xFF

RX Amplifier

- OP Amp with a fixed internal voltage reference
- Voltage Gain of 5 is defined by external resistor

$$G \quad \frac{R2}{R1} \qquad \frac{150k}{47k} = 3.19$$

Band-Pass Filter and Limiter

- No external components for Filtering and Amplification
- Converts Analog Sine-wave signal to a digital signal
- High gain of at least 1000

SCI Encoder for data Transmission to controller

- An 8 bit shift register is used to send the received data byte-wise to the micro controller (**L**east **S**ignificant **B**it **first**)
- Transmission rate 15.625 kBaud (asynchronous mode)
  one start-byte (high) and one stop-byte (low)
  Date bits are inverted with respect to the corresponding bits sent by the TRP
- The Start Byte is the first Byte what is sent to the micro controller
- Typical values: 0x81(0x7E) ****** 0x01 (0xFE)
- In the Synchronous Mode A High state at the SCSI output indicates that a new byte is ready to be transmitted.

7-bit Mode Control Register

Start Bit	Bit 0		0	The Start Bit is Always LOW
Data Bit1	Bit 1			Frequency Selection
Data Bit2	Bit 2			Frequency Selection
Data Bit3	Bit 3			Frequency Selection
Data Bit4	Bit 4			Frequency Selection
Data Bit5	Bit 5	SCI_Sync (default)	0 1	Asynchronous data transmission Synchronous data transmission
SCI_Sync	Bit 6	RX_AFC(default)	0 1	Demodulator threshold is adapted automatically Demodulator threshold is defined by Bit 1-4
Test_Bit	Bit 7	Test_Bit(default) (only for internals tests)	0 1	No further test bytes Further test byte follows for special test modes

- The first 4 Bit in high state enables the base station to adjust automatically the carrier frequency to the transponder resonance frequency
- Other combinations allows to select the the frequency individually by the division factor of 114 to 124 (default is 119 , if no write to the MCR is performed)

Frequency selection Table

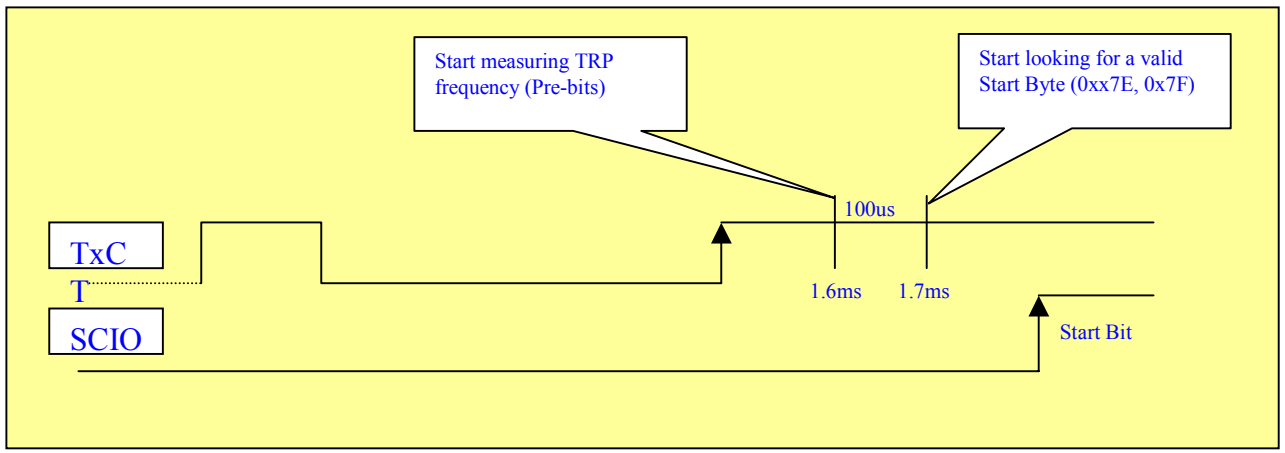
Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Division factor	
0	0	0	0	0	119	Micro Controller selects division factor Reset
0	1	0	0	0	114	Micro Controller selects division factor
0	0	1	0	0	115	Micro Controller selects division factor
0	1	1	0	0	116	Micro Controller selects division factor
0	0	0	1	0	117	Micro Controller selects division factor
0	1	0	1	0	118	Micro Controller selects division factor
0	0	1	1	0	119	Micro Controller selects division factor
0	1	1	1	0	120	Micro Controller selects division factor
0	0	0	0	1	121	Micro Controller selects division factor
0	1	0	0	1	122	Micro Controller selects division factor
0	0	1	0	1	123	Micro Controller selects division factor
0	1	1	0	1	124	Micro Controller selects division factor
0	1	1	1	1	Auto	Division factor is adapted automatically

Digital Demodulator

- The received input frequency is measured by counting the oscillation clock for the time period of the input signal
- The Demodulator distinguish between the the high-bit frequency and and the low-bit frequency by the shift between the frequencies and **NOT** by the absolute values.
- The threshold between the High-bit and the Low-bit is defined by 6.5kHz lower than the measured low-bit frequency
- After the charge phase the TRP response frequency will be measured to determine the counter state for the low –bit and high-bit threshold

Transponder Resonance – Frequency Measurement

- When TXCT becomes high again the module enters the read phase
- 1.6ms after TXCT is high an internal measuring cycle with 100us will start to measure the Low Bit frequency of the 16 TRP Pre-Bits.
- 1.7 ms after TXCT is high the IC starts looking for valid Start byte.



SCI Encoder

- The SCI encoder performs the data transmission to the micro-controller.
- Because of the lower transmission rate of the TRP the serial bit flow is buffered in a 8-bit register
- Received Data will be sent byte-wise. **L**east **S**ignificant **B**it first.
- Transmission rate of 15.625kbaud in the asynchronous mode. (default)
  One start-bit(**high**) and one stop-bit (**low**)
- The data bits at the SCIO output are inverted with respect to the corresponding bits sent by the Transponder

SCIO Data format

- The data bits at the SCIO output are inverted with respect to the corresponding bits sent by the transponder.
- The first sent data byte will be the Start-Byte.
- Typical values:

R/O: TRP $7E; 3705 sends $81

R/W: TRP $FE; 3705 sends $01

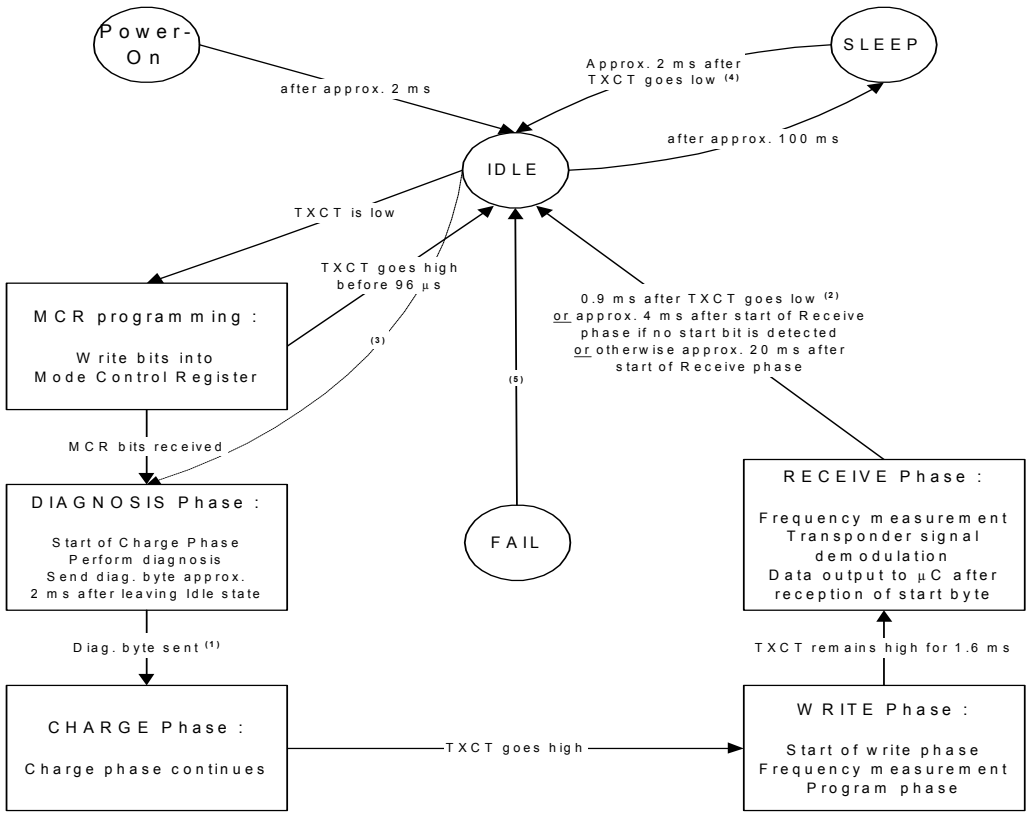
DST: TRP $7E; 3705 sends $81

SCIO in Synchronous transmission mode

- The SCI encoder can be switched into a synchronous transmission mode by setting the SYNC bit in the the MCR to high.
- The micro-controller has to clock out the data byte by sending 8 clock-signals to the TXCT input.
- A high state on the SCIO indicated that a new byte is ready to be transmitted.
- Advantage: Higher speed of the Byte transmission.

  Minimum clock period of 4us x 8,5 = 36us per Byte.

State Diagram



Notes :

(1) In SCI synchronous mode, this transition always occurs approx. 3 ms after leaving Idle state (diag. byte transmission should be completed before).

(2) A falling edge on TXCT interrupts the Receive phase after a delay of 0.9 ms. TXCT must remain low for at least 128 µs. If TXCT is still low after the 0.9 ms delay, the basestation will go to Idle and directly to the Diagnosis phase one clock cycle later (Dotted line (3)). No MCR can be written, only default mode is fully supported in this case.
Otherwise, if TXCT returns to high and remains high during the delay, the basestation will stay in Idle and wait for TXCT to go low (this will start properly a new MCR programming) or wait for 100 ms to go to Sleep.

(3) This transition only occurs in a special case (see note (2))

(4) A falling edge on TXCT interrupts the Sleep state. Only default mode is fully supported when starting an operation from Sleep with only one falling edge on TXCT (because of the 2 ms delay). For a proper MCR programming, TXCT has to return to high and remain high during this delay.

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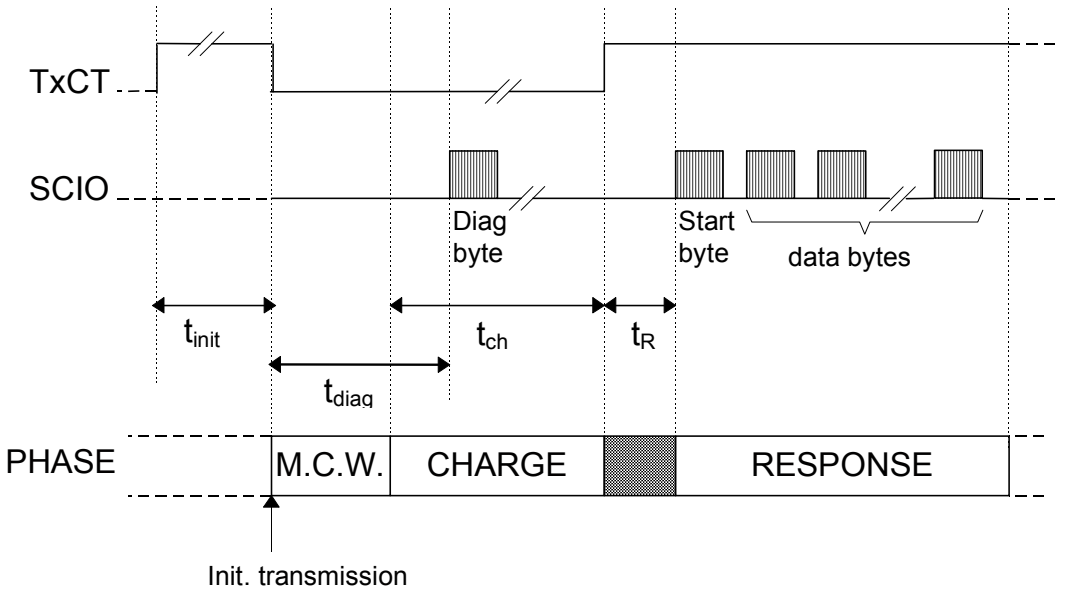
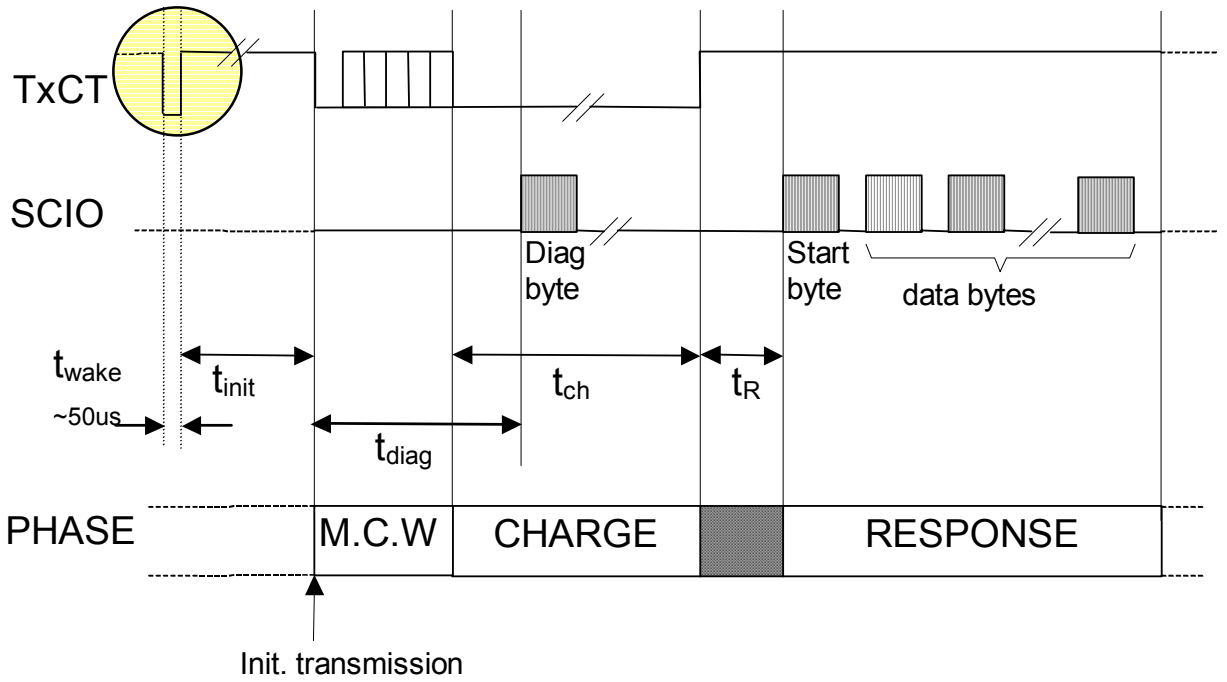
Timing Diagram
Default Mode, no Writing into MCR

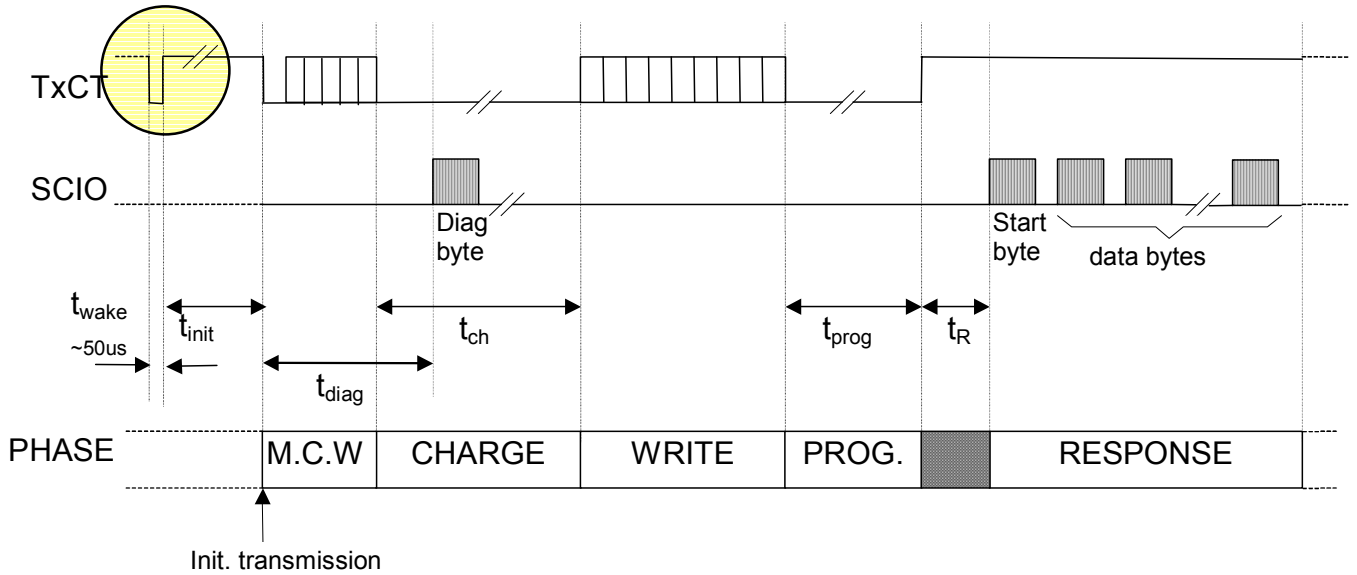


Timing Diagram
R/O Mode with Writing into the MCR



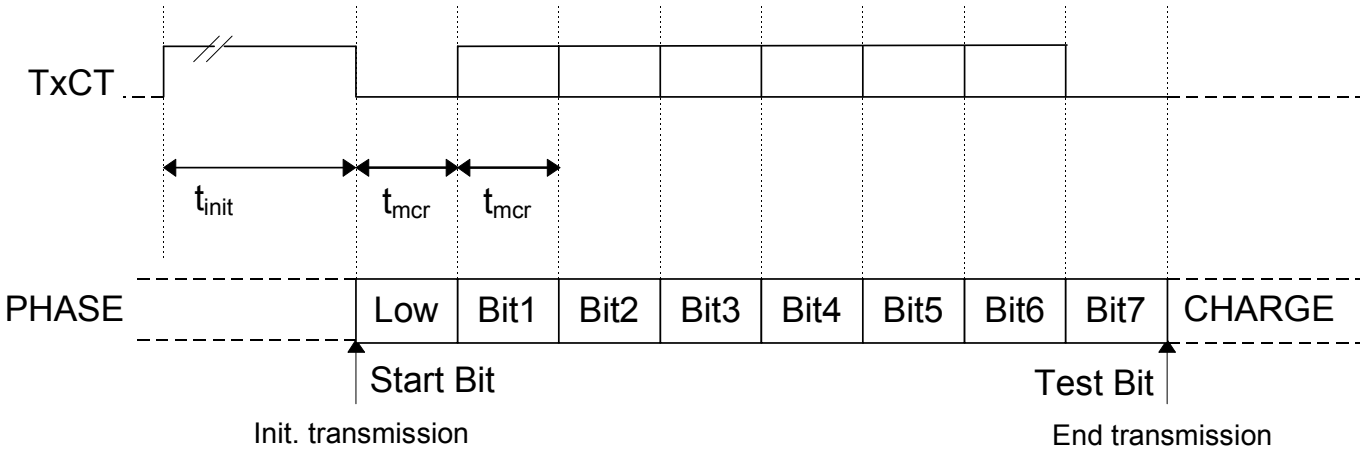
! For proper M.C.W. it is essential to know if the TMS3705A is in the IDLE or SLEEP Mode

Timing Diagram
Read/Write Mode with Writing into the MCR

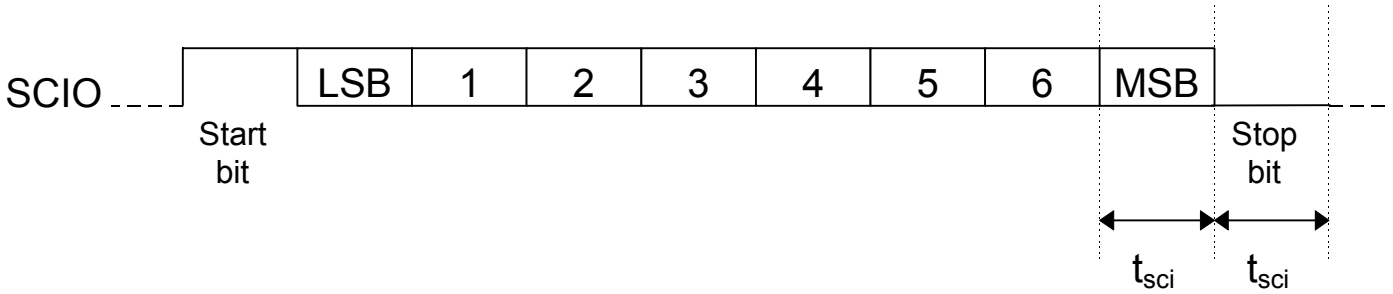


! For proper M.C.W. it is essential to know if the TMS3705A is in the IDLE or SLEEP Mode

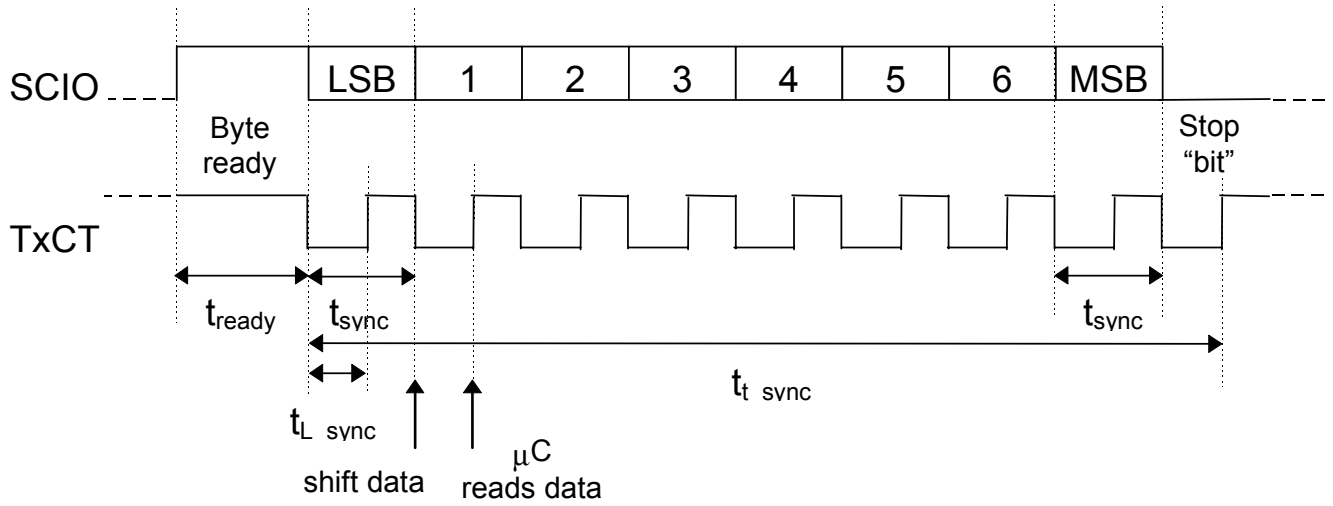
Timing Diagram
Mode Control Register Write Protocol



Timing Diagram
Asynchronous transmission on SCIO



Timing Diagram
Synchronous transmission on SCIO



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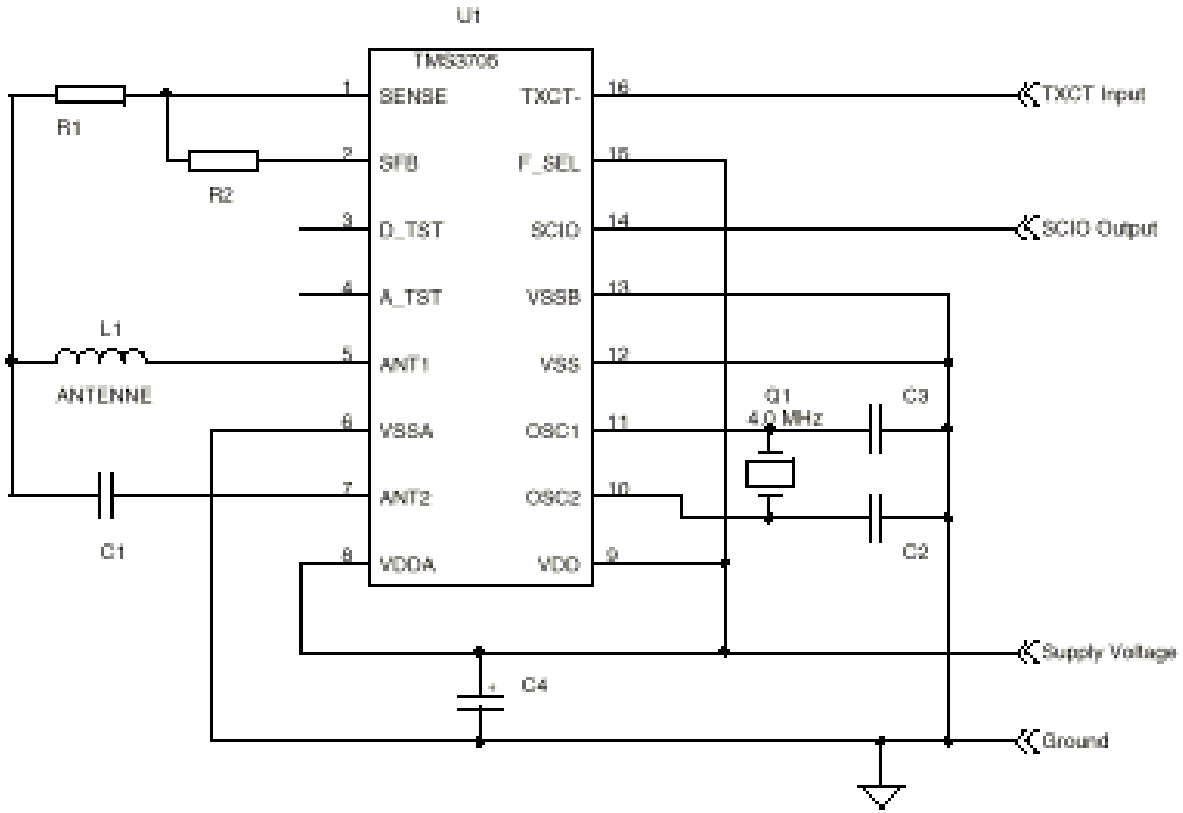
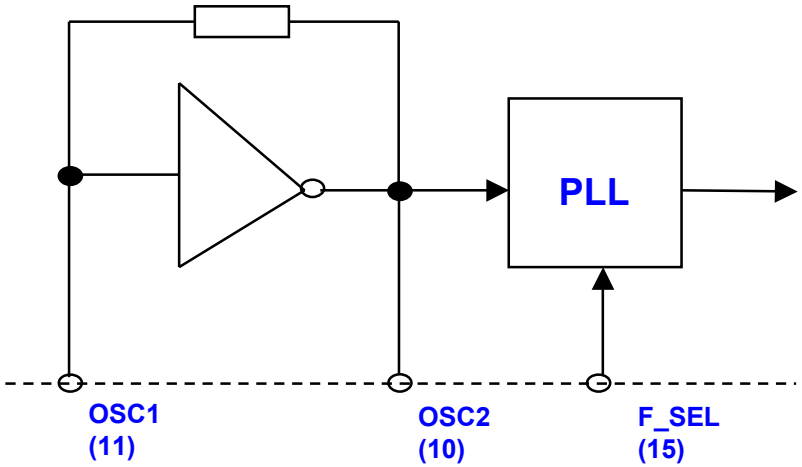
Generic Schematic Diagram



Oscillator - PLL

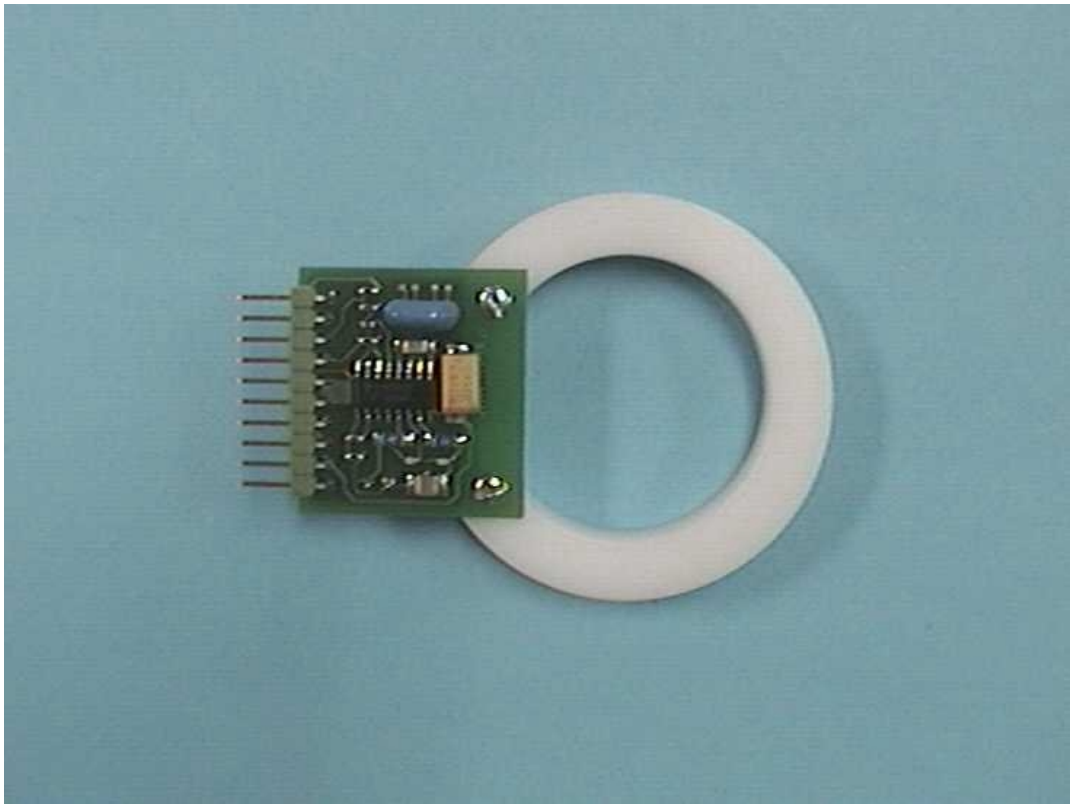


- In case a Ceramic resonator is used a device with an internal load capacitance of about 56pF is recommended
- An external oscillator signal can be fed into OSC1 . OSC2 has to be left open (decoupling capacitor is recommended)

Main Recommendations

- Antenna Inductance 400 – 700 uH
- System Q RX/TX (Automotive) maximum10
- Ceramic Resonator with internal load capacitance of about 56pF

RF Demo Module including Antenna



Questions