

# SIEMENS



## ICs for Communications

PLL-Frequency Synthesizer

PMB2306R/PMB2306T Version 2.2

Data Sheet 02.97

T2306-0V22-D1-7600

<b>PMB2306R/PMB2306T</b>		
<b>Revision History:</b>		<b>Current Version: 02.97</b>
Previous Version: 01.94		
Page (in previous Version)	Page (in new Version)	Subjects (major changes since last revision)
14-15	19-20	<b>AC/DC Characteristics</b> H-input current $I_H$ : is changed from 10 $\mu$ A to 30 $\mu$ A and L-input current $I_L$ : is changed from -10 $\mu$ A to -30 $\mu$ A
26	26	<b>Clock frequency</b> $f_{CL}$ max. is changed from 10MHz to 12MHz; <b>H-pulsewidth (CL)</b> $t_{WHCL}$ min. is changed from 60ns to 40ns; <b>H-pulsewidth (enable)</b> $t_{WHEN}$ min. is changed from 60ns to 40ns;
18	18	Input reference frequency $f_{CRI}$ : is changed from 20MHz to 22MHz
19	19	<b>Input Signal RI</b> Input voltage $V_i$ : is changed from 20MHz to 22MHz

#### Edition 02.97

This edition was realized using the software system FrameMaker®.

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## 1 Overview

### 1.1 Features

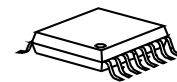
- Low operating current consumption (typically 3.5 mA)
- High input sensitivity, high input frequencies (220 MHz)
- Extremely fast phase detector without dead zone
- Linearization of the phase detector output by current sources
- Synchronous programming of the counters (n-, n/a-, r-counters) and system parameters
- Fast modulus switchover for 65-MHz operation
- Switchable modulus trigger edge
- Large dividing ratios for small channel spacing  
A scaler 0 to 127  
N scaler 3 to 16.380  
R scaler 3 to 65.535
- Serial control (3-wire bus: data, clock, enable) for fast programming ( $f_{max} \sim 10$  MHz)
- Switchable polarity and phase detector current programmable
- 2 Multifunction outputs
- Digital phase detector output signals (e.g. for external charge pump)
- $f_{rn}, f_{vn}$  outputs of the R and N scalars
- Port 1 output (e.g. for standby of the prescaler)
- External current setting for PD output
- Lock detect output with gated anti-backlash pulse (quasi digital lock detect)

**PMB2306T**



**P-DSO-14**

**PMB 2306R**

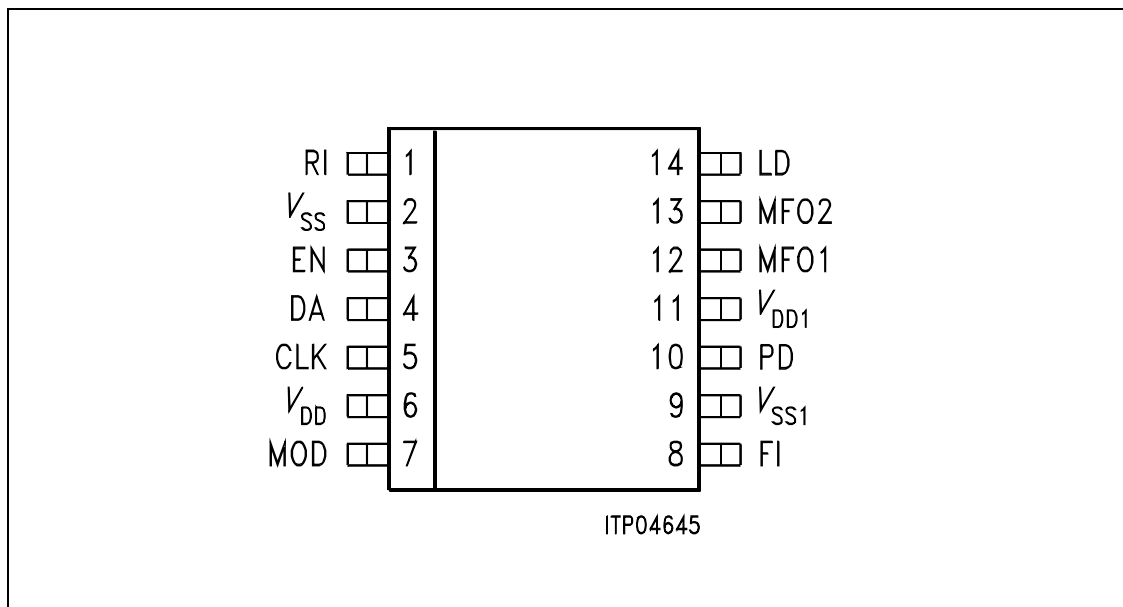


**P-TSSOP-16**

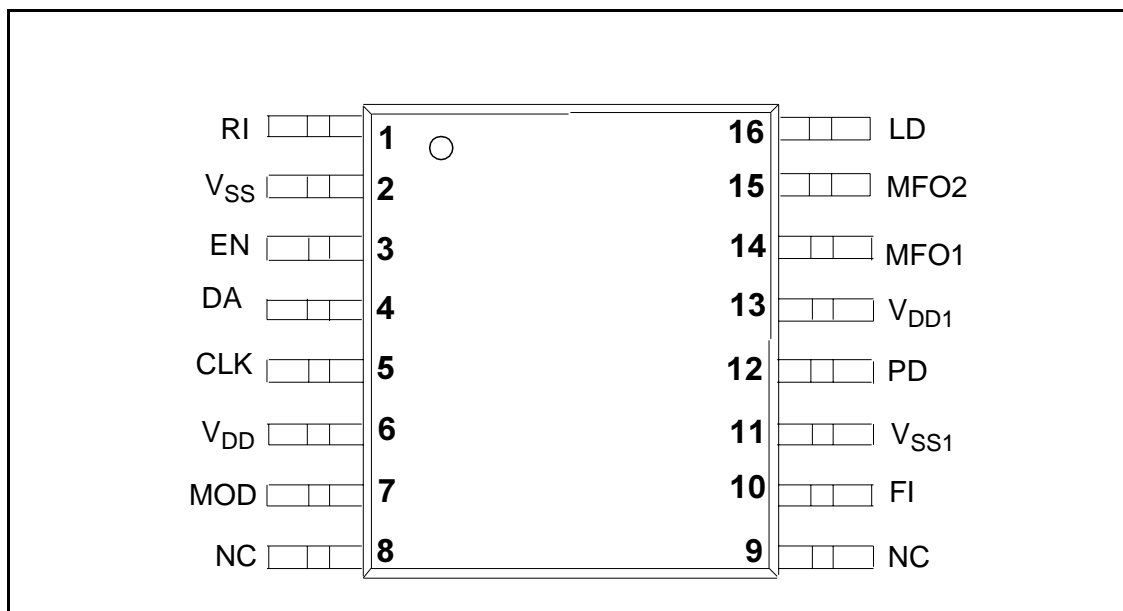
Type	Version	Ordering Code	Package
PMB 2306T	V2.2	Q67100-H6423	P-DSO-14 (SMD)
PMB 2306T	V2.2	Q67106-H6423	P-DSO-14 (SMD, Tape & Reel)
PMB 2306R	V2.2	Q-67106-H6514 (T&R)	P-TSSOP-16 (SMD, T&R)

The PMB 2306T PLL is a high speed CMOS IC, especially designed for use in battery powered radio equipment and mobile telephones. The primary applications will be in digital systems e.g. GSM, PCN, ADC, JDC and DECT systems. The wide range of dividing ratios also allows application in modern analog systems

### 1.2 Pin Configuration (top view)



**P-DSO-14**



**P-TSSOP-16**

## 1.3 Pin Definitions and Functions

Table 1

DSO-14	TSSOP-16	Symbol	Function
6	6	$V_{DD}$	Positive supply voltage for serial control logic.
2	2	$V_{SS}$	Ground for serial control logic.
11	13	$V_{DD1}$	Positive supply voltage for the preamplifiers, counters, phase detector and charge pump.
9	11	$V_{SS1}$	Ground for the preamplifiers, counters, phase detector and charge pump. <b>(Note: The pins <math>V_{DD}</math> and <math>V_{DD1}</math> respectively <math>V_{SS}</math> and <math>V_{SS1}</math> have to have the same supply voltage.)</b>
3	3	EN	<b>3-Line Bus: Enable</b> Enable line of the serial control with internal pull-up resistor. When EN = H the input signals CLK and DA are disabled internally. When EN = L the serial control is activated. The received data are transferred into the latches with the positive edge of the EN-signal.
4	4	DA	<b>3-Line Bus: Data</b> Serial data input with internal pull-up resistor. The last two bits before the EN-signal define the destination address. In a byte-oriented data structure the transmitted data have to end with the EN-signal, i.e. bits to be filled in (don't care) are transmitted first.
5	5	CLK	<b>3-Line Bus: Clock</b> Clock line with internal pull-up resistor. The serial data are read into the internal shift register with the positive edge (see pulse diagram for serial data control).
7	7	MOD	<b>Modulus Control Output</b> for external dual modulus prescaler. The modulus output is low at the beginning of the cycle. When the a-counter has reached its set value, MOD switches to high. When the n-counter has reached its set value, MOD switches to low again, and the cycle starts from the top. When the prescaler has the counter factor P or P + 1 (P for MOD = H, P + 1 for MOD = L), the overall scaling factor is NP + A. The value of the a-counter must be smaller than that of the n-counter. The trigger edge of the modulus signal to the input signal can be selected (see programming tables and MOD A, B) according to the needs of the prescaler. In single modulus operation and for standby operation in dual modulus operation, the output is low.

**Table 1**

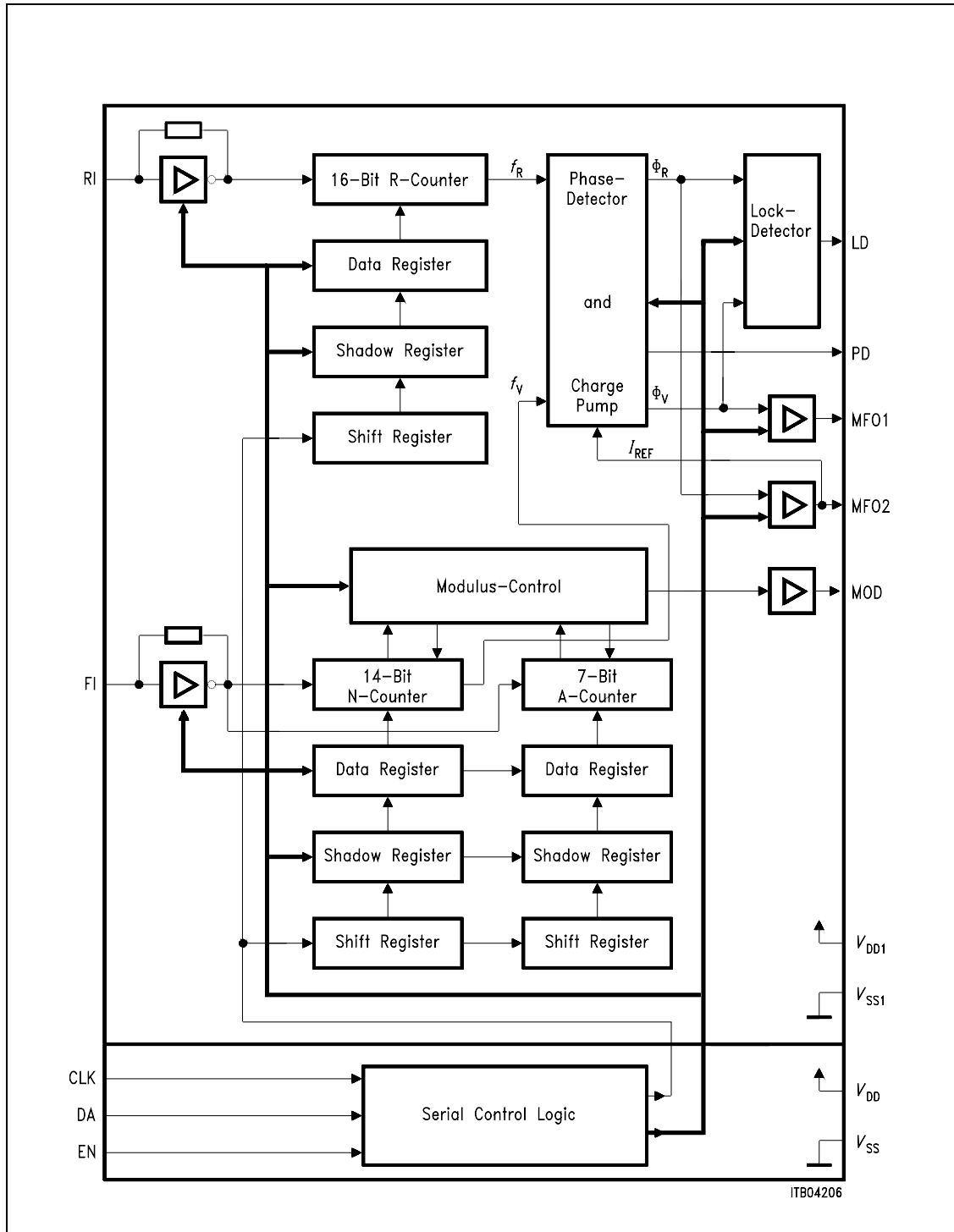
DSO-14	TSSOP-16	Symbol	Function
8	10	FI	<b>VCO-Frequency</b> Input with highly sensitive preamplifier for 14-bit n-counter and 7-bit a-counter. With small input signals AC coupling must be set up, where DC coupling can be used for large input signals.
1	1	RI	<b>Reference Frequency</b> Input with highly sensitive preamplifier for 16-bit r-counter. With small input signals AC coupling must be set up, where DC coupling can be used for large input signals.
10	12	PD	<b>Phase Detector</b> Tristate charge pump output. The integrated, positive and negative current sources can be programmed with respect to their current density by means of the serial control. Activation and deactivation depend on the phase relationship of the scaled-down input signals FI:N, RI:R. (See phase detector output waveforms.) frequency $f_V < f_R$ or $f_V$ lagging: p-channel current source active frequency $f_V > f_R$ or $f_V$ leading: n-channel current source active frequency $f_V = f_R$ and PLL locked: current sources are switched off, PD-output is tristate In standby mode the PD-output is set to tristate. The assignment of the current sources to the output signals of the phase detector can be swapped in it's polarity, i.e. the sign of the phase detector constant can be controlled.
14	16	LD	<b>Lock Detector Output</b> (open drain). Unipolar output of the phase detector in the form of a pulse-width modulated signal. The L-pulse width corresponds to the phase difference. Phase differences < 20 ns are not indicated due to gating of the antibacklash impuls. In the locked state the LD-signal is at H-level. In standby mode the output is resistive. Only for ABL status 11 no gating of ABL impulse is performed.

**Table 1**

DSO-14	TSSOP-16	Symbol	Function
12	14	MFO1	<b>Multifunction Output</b> for the signals $f_{RN}$ , $\Phi_V$ , $\Phi_{VN}$ and port 1.
13	15	MFO2	<p><b>Multifunction I/O-Pin</b> for the output signals <math>f_{VN}</math>, <math>\Phi_{RN}</math> and the input signal <math>I_{REF}</math>.</p> <ul style="list-style-type: none"> <li>– The signals <math>\Phi_R</math> and <math>\Phi_V</math> are the digital output signals of the phase and frequency detector for use in external active current sources (see phase detector output wave forms).</li> <li>– The signals <math>f_{RN}</math> and <math>f_{VN}</math> are the scaled down signals of the reference frequency and VCO-frequency. The L-time corresponds to <math>1/f_{RI}</math> and <math>1/f_{FI}</math> respectively.</li> <li>– In the port function the port 1 output signal is assigned to the information of the status program. The output switches with the rising edge of the EN-signal. The standby mode does not affect the port function.</li> <li>– In the internal charge pump mode the input signal <math>I_{REF}</math> determines the value of the PD-output current.</li> </ul> <p>Reference current for charge pump:</p> $I_{REF} = (V_{DD} - V_{REF})/R1$ <p style="margin-left: 40px;">= 100<math>\mu</math>A (tolerance of <math>\pm 20\%</math> or less is recommended)</p> <p>R1:see application circuit  <math>V_{REF}</math>:see AC/DC characteristics</p>



1.4 Functional Block Diagram



## 2 Circuit Description

### General Description

The circuit consists of a reference-, a- and n-counter, a dual modulus control logic, a phase detector with charge pump output and a serial control logic. The setting of the operating mode and the selection of the counter ratios is done serially at the ports CLK, DA and EN.

The operating modes allow the selection of single or dual operation, asynchronous or synchronous data acquisition, 4 different antibacklash-impulse times, 8 different PD-output current modes, polarity setting of the PD-output signal, adjustment of the trigger-edge of the MOD-output signal, 2 standby modes and the control of the multifunction outputs MFO1 and MFO2.

The reference frequency is applied at the RI-input and scaled down by the r-counter. It's maximum value is 100 MHz. The VCO-frequency is applied at the FI-input and scaled down by the n- or n/a-counter according to single or dual mode operation. The maximum value at FI is 220 MHz at single-, and 65 MHz at dual mode operation.

The phase and frequency sensitive phase detector produces an output signal with adjustable anti-backlash impulses in order to prevent a dead zone for very small phase deviations. Phase differences of less than 100 ps can be resolved. In general the shortest anti-backlash pulse gives the best system performance.

### Programming

Programming of the IC is done by a serial data control. The contents of the message are assigned to the functional units according to the address. **Single or dual mode operation as well as asynchronous or synchronous data acquisition is set by status 2 and should therefore precede the programming of the counters.**

### Data acquisition

The PMB 2306T offers the possibility of synchronous data acquisition to avoid error signals at the phase detector due to non-corresponding dividing factors in the counters produced by asynchronous loading.

Synchronous programming guarantees control during changes of frequency or channel. That means that the state of the phase detector or the phase difference is kept maintained, and in case of "lock in", the control process starts with the phase difference "zero".

This is done as follows:

1. Setting of synchronous data acquisition by status 2.
2. Programming of the r-counter, status 1 (optional)-data is being loaded into shadow registers.
3. Programming of the n- or n/a-counter-data is being loaded into shadow registers, the EN-signal starts the synchronous loading procedure.
4. Synchronous programming – which means data transfer of all data from the shadow registers to the data registers – takes place at that point in time when the respective counter reaches “zero + 1”, the maximum repetition rate for channel change is therefore  $f_{Fi} \cdot N$ .
5. Transfer of status 1 information into the corresponding data register is tied to the n-counter loading, but follows the loading of the n-data register in the distance of one n-counter dividing ratio, this guarantees that for example a new PD-current value becomes valid at the same time when the counters are loaded with the new data.

Synchronous avoids additional phase error caused by programming. Synchronous data acquisition is of especial advantage, when large steps in frequency are to be made in a short time. For this purpose a high reference frequency can be programmed in order to achieve rapid – “rough” – transient response. This method increases the fundamental frequency nearly by the square route of the reference frequency relation. When rough lock is achieved, another synchronous data transfer is needed to switch back to the original channel spacing. A “fine” lock in will finish the total step response. It may not be necessary to change reference frequency, but it make sense to perform synchronous data acquisition in any case. Especially for GSM, PCN, DECT, DAMPS, JDC, PHP systems the synchronous mode should be used to get best performance of the PMB 2306T.

### Standby Condition

The PMB 2306T has two standby modes (standby 1, 2) to reduce the current consumption.

Standby 1 switches off the whole circuit, the current consumption is reduced below 1  $\mu$ A.

Standby 2 switches off the counters, the charge pump and the outputs, only the preamplifiers stay active.

The standby modes do not affect the port output signal. For the influence on the other output signals **see standby table**.

*Note:*  $f_{RN}$ ,  $f_{VN}$ ,  $\Phi_{RN}$  and  $\Phi_{VN}$  are the inverted signals of  $f_R$ ,  $f_V$ ,  $\Phi_R$  and  $\Phi_V$ .

### Programming Tables

Status Bits		Multifunction Outputs		
Mode 2	Mode 1	MFO 1	MFO 2	Remarks
0	0	$f_{RN}$	$f_{VN}$	test mode
0	1	$\Phi_V$	$\Phi_{RN}$	external charge pump mode 1
1	0	$\Phi_{VN}$	$\Phi_{RN}$	external charge pump mode 2
1	1	Port 1	$I_{REF}$	internal charge pump mode

Status Bits			PD-Current Mode
PD-Current 3	PD-Current 2	PD-Current 1	
0	0	0	0.175
0	0	1	0.25
0	1	0	0.35
0	1	1	0.5
1	0	0	0.7
1	0	1	1
1	1	0	1.4
1	1	1	2

### Programming Tables (cont'd)

Status Bits			
Anti-Backlash Pulse Width 2	Anti-Backlash Pulse Width 1	$t_w$ (typ.) [ns]	Application
0	0	1.3*	$V_{DD} = 5 V$
0	1	5	
1	0	10	not recommended
1	1	13**	any application where continuous lock detect required

\* In general the shortest anti-backlash pulse gives the best system performance.

\*\* No ABL (Anti-Backlash-Pulse) gating performed. This means, that at the LD output the anti-backlash pulse will appear. In the other cases the anti-backlash pulse will be suppressed at the LD output.

## Circuit Description

Status Bits		Preamplifier Function Mode
Single/ Dual Mode	Preamplifier Select	
0	0	FI-input frequency, single HF-mode
0	1	FI-input frequency, single LF-mode
1	0	FI-input frequency, dual mode, FI-trigger edge LH, MOD A
1	1	FI-input frequency, dual mode, FI-trigger edge HL, MOD B

## Standby Table

Status	Output Pins					MOD
	MFO 1		MFO 2	LD	PD	
	$\Phi_V$	$\Phi_{VN}$				
Standby 1	low	high	high	resistive	tristate	low
Standby 2	low	high	high	resistive	tristate	low

### Serial Control Data Format (status 1, 2)

#### Status 1

1
2
3
4
5
6

EN

Data acquisition mode
Mode 1
Mode 2
PD-polarity
Standby 1
Standby 2
Anti-backlash pulse width 1
Anti-backlash pulse width 2
Preamplifier select
Single / dual mode
Port 1
PD-current 1
PD-current 2
PD-current 3
0 Address 0
0 1

#### Status 2

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

EN

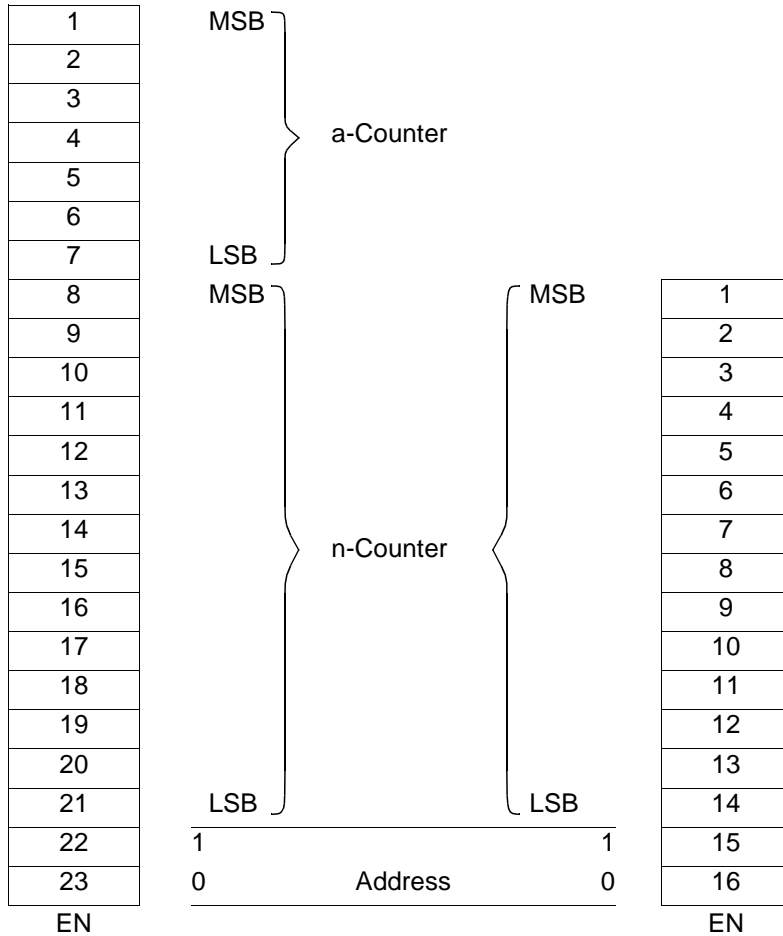
0	1
asynchronous	synchronous
see table	
see table	
negative	positive
standby	active
standby	active
see table	
see table	
see table	
single	dual
low	high
see table	
see table	
see table	

**Single or dual mode operation as well as asynchronous or synchronous data acquisition is set by status 2 and should therefore precede the programming of the counters. (see also page 10)**

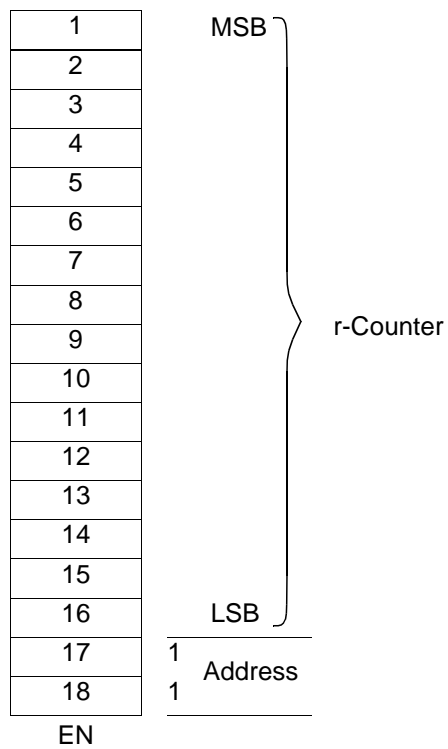
**Serial Control Data Format (n-, n/a-counter)**

**Dual Mode**

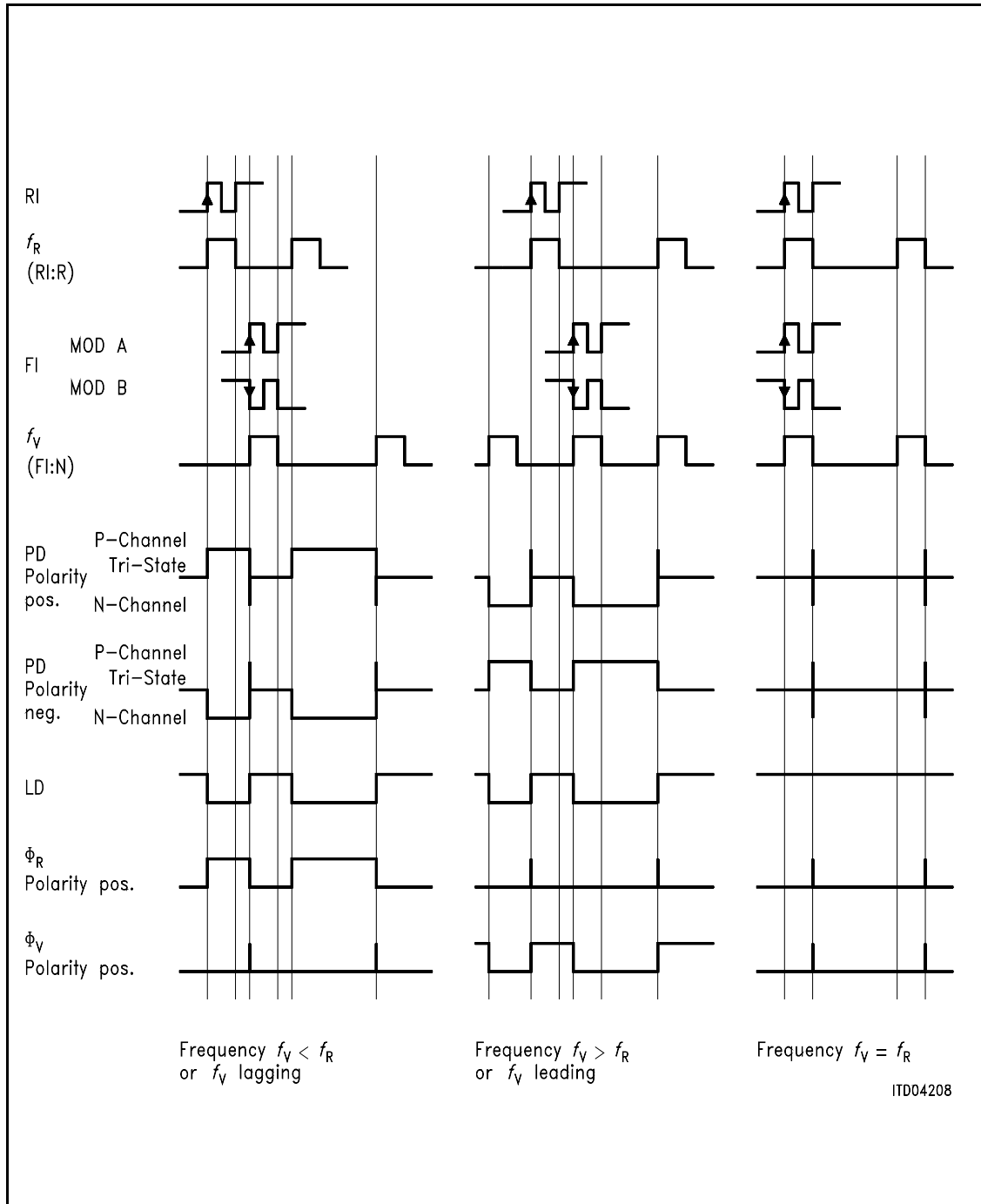
**Single Mode**



## Serial Control Data Format (r-counter)







**Phase Detector Output Waveforms**

## Electrical Characteristics

### 3 Electrical Characteristics

#### 3.1 Absolute Maximum Ratings

$T_A = -40$  to  $85$  °C

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Supply voltage	$V_{DD}$	- 0.3	6	V	
Input voltage	$V_I$	- 0.3	$V_{DD} + 0.3$	V	
Output voltage	$V_Q$	GND	$V_{DD}$	V	
Power dissipation per output	$P_Q$		10	mW	
Total power dissipation	$P_{tot}$		300	mW	
Ambient temperature	$T_A$	- 40	85	°C	in operation
Storage temperature	$T_{stg}$	- 50	125	°C	

#### Operating Range

Supply voltage	$V_{DD}$	3.0	5.5	V	
Input frequency dual mode	$f_{FI}$	0.1	65	MHz	$V_{DD} = 4.5 \dots 5.5$ V
Input frequency single HF-mode	$f_{FI}$	0.1	220	MHz	$V_{DD} = 4.5 \dots 5.5$ V
Input frequency single LF-mode	$f_{FI}$	0.1	90	MHz	$V_{DD} = 4.5 \dots 5.5$ V
Input reference frequency	$f_{RI}$		100	MHz	$V_{DD} = 4.5 \dots 5.5$ V
Input frequency dual mode	$f_{FI}$	0.1	30	MHz	$V_{DD} = 3.3$ V
Input frequency single HF-mode	$f_{FI}$	0.1	120	MHz	$V_{DD} = 3.3$ V
Input frequency single LF-mode	$f_{FI}$	0.1	35	MHz	$V_{DD} = 3.3$ V
Input reference frequency	$f_{RI}$		22	MHz	$V_{DD} = 3.3$ V
PD-output current	$I_{PD}$		4	mA	
PD-output voltage	$V_{PD}$	0.5	$V_{DD} - 0.5$	V	$V_{DD} = 4.5 - 5.5$ V
PD-output voltage	$V_{PD}$	0.5	$V_{DD} - 0.5$	V	$V_{DD} = 3.3$ V
Ambient temperature	$T_A$	- 40	85	°C	

All pins are protected against ESD. Unused inputs without pullup resistors must be connected to either  $V_{DD}$  or  $V_{SS}$ .

#### 3.2 Typical Supply Current $I_{DD}$

Supply voltage	$V_{DD}$	3.3	5	5.5	V	Test conditions:
Supply current singlemode HF	$I_{DD}$	1.63	2.6	2.94	mA	$f_{FI} = 50$ MHz, $V_{FI} = 150$ mVrms $f_{RI} = 10$ MHz, $V_{RI} = 150$ mVrms $I_{PD} = 0.25$ mA, $I_{ref} = 100$ $\mu$ A
dual mode	$I_{DD}$	1.76	2.80	3.17	mA	
standby 2	$I_{DD}$	0.11	0.62	0.75	mA	
standby 1	$I_{DD}$			1	$\mu$ A	

## Electrical Characteristics

### 3.3 AC/DC Characteristics

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		

#### Input Signals DA, CLK, EN (with internal pull-up resistors)

H-input voltage	$V_{IH}$	$0.7 V_{DD}$		$V_{DD}$	V	
L-input voltage	$V_{IL}$	0		$0.3 V_{DD}$	V	
Input capacity	$C_i$			5	pF	
H-input current	$I_H$			10	$\mu A$	$V_i = V_{DD} = 5.5 V$
L-input current	$I_L$	-300			$\mu A$	$V_i = GND$

Further information about timing see at page 25 and 26

#### Input Signal RI

Input voltage	$V_i$	100			mVrms	$f = 4 \dots 100 \text{ MHz}$ , $V_{DD} = 4.5 V$
Input voltage	$V_i$	100			mVrms	$f = 4 \dots 22 \text{ MHz}$ , $V_{DD} = 3.3 V$
Slew rate		2.5			V/ $\mu s$	$V_{DD} = 3.3 \dots 5.5 V$
Input capacity	$C_i$			3	pF	
H-input current	$I_H$			30	$\mu A$	$V_i = V_{DD} = 5.5 V$
L-input current	$I_L$	-30			$\mu A$	$V_i = GND$

#### Input Signal FI (dual mode)

Input voltage	$V_i$	180			mVrms	$f = 4 \dots 65 \text{ MHz}$ , $V_{DD} = 4.5 V$
Input voltage	$V_i$	180			mVrms	$f = 4 \dots 30 \text{ MHz}$ , $V_{DD} = 3.3 V$
Input voltage	$V_i$	50			mVrms	$f = 10 \dots 30 \text{ MHz}$ , $V_{DD} = 3.3 V$
Slew rate		4			V/ $\mu s$	$V_{DD} = 3.3 \dots 5.5 V$
Input capacity	$C_i$			3	pF	
H-input current	$I_H$			30	$\mu A$	$V_i = V_{DD} = 5.5 V$
L-input current	$I_L$	-30			$\mu A$	$V_i = GND$

#### Input Signal FI (single HF-mode)

Input voltage	$V_i$	200			mVrms	$f = 4 \dots 220 \text{ MHz}$ , $V_{DD} = 4.5 V$
Input voltage	$V_i$	20			mVrms	$f = 4 \dots 120 \text{ MHz}$ , $V_{DD} = 3.3 V$
Input voltage	$V_i$	50			mVrms	$f = 10 \dots 50 \text{ MHz}$ , $V_{DD} = 4.5 V$
Slew rate		2.5			V/ $\mu s$	$V_{DD} = 3.3 \dots 5.5 V$
Input capacity	$C_i$			3	pF	
H-input current	$I_H$			30	$\mu A$	$V_i = V_{DD} = 5.5 V$
L-input current	$I_L$	-30			$\mu A$	$V_i = GND$

## Electrical Characteristics

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		

### Input Signal FI (single LF-mode)

Input voltage	$V_I$	100			mVrms	$f = 4 \dots 90 \text{ MHz}, V_{DD} = 4.5 \text{ V}$
Input voltage	$V_I$	100			mVrms	$f = 4 \dots 35 \text{ MHz}, V_{DD} = 3.3 \text{ V}$
Slew rate		2.5			V/ $\mu\text{s}$	$V_{DD} = 3.3 \dots 5.5 \text{ V}$
Input capacity	$C_I$			3	pF	
H-input current	$I_H$			30	$\mu\text{A}$	$V_I = V_{DD} = 5.5 \text{ V}$
L-input current	$I_L$	-30			$\mu\text{A}$	$V_I = \text{GND}$

### Output Current $I_{PD}$

Current mode						
“0.175 mA”	$I_{PROG}$	-20 %		+20 %	mA	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ $V_{PD} = V_{DD}/2$ $I_{REF} = 100 \mu\text{A}$
“0.25 mA”	$I_{PROG}$	-20 %		+20 %	mA	
“0.35 mA”	$I_{PROG}$	-20 %		+20 %	mA	
“0.5 mA”	$I_{PROG}$	-20 %		+20 %	mA	
“0.7 mA”	$I_{PROG}$	-20 %		+20 %	mA	
“1.0 mA”	$I_{PROG}$	-10 %		+10 %	mA	
“1.4 mA”	$I_{PROG}$	-10 %		+10 %	mA	
“2.0 mA”	$I_{PROG}$	-10 %		+10 %	mA	
“Standby”	$I_{PD} /$		0.1*	50	nA	$V_{DD} = 5.5 \text{ V}$
* guaranteed by design						

### Output Tolerances $I_{PD}$

$\Delta I_{PD} / I_{PROG}$		-20 %		+3 %		$V_{PD} = V_{DD}/2, V_{DD} = 3.3 \text{ V}$
$\Delta I_{PD} / I_{PROG}$			$\pm 4\%$			$V_{PD} = 1 \dots 4 \text{ V}, V_{DD} = 5 \text{ V}$

### Input Voltage MFO2 (internal charge pump mode)

Reference voltage	$V_{REF}$	0.9	1.1	1.3	V	$V_{DD} = 4.5 \dots 5.5 \text{ V},$ $I_{REF} = 100 \mu\text{A}$
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## Electrical Characteristics

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		

### Output Signal MFO1 (push pull)

H-output voltage	$V_{QH}$	$V_{DD} - 1$			V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QH} = 2 \text{ mA}$
L-output voltage	$V_{QL}$			1	V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QL} = 2 \text{ mA}$
H-output voltage	$V_{QH}$	$V_{DD} - 1$			V	$V_{DD} = 3.3 \text{ V}$ , $I_{QH} = 1.2 \text{ mA}$
L-output voltage	$V_{QL}$			1	V	$V_{DD} = 3.3 \text{ V}$ , $I_{QL} = 1.2 \text{ mA}$
Rise time	$t_R$		2.5	10	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 10 \text{ pF}$
Fall time	$t_F$		2.0	10	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 10 \text{ pF}$
Rise time	$t_R$		4.0	10	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 10 \text{ pF}$
Fall time	$t_F$		2.5	10	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 10 \text{ pF}$

### Output Signal MFO2 (push pull)

H-output voltage	$V_{QH}$	$V_{DD} - 1$			V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QH} = 2 \text{ mA}$
L-output voltage	$V_{QL}$			1	V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QL} = 2 \text{ mA}$
H-output voltage	$V_{QH}$	$V_{DD} - 1$			V	$V_{DD} = 3.3 \text{ V}$ , $I_{QH} = 1.2 \text{ mA}$
L-output voltage	$V_{QL}$			1	V	$V_{DD} = 3.3 \text{ V}$ , $I_{QL} = 1.2 \text{ mA}$
Rise time	$t_R$		2	10	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 10 \text{ pF}$
Fall time	$t_F$		2	10	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 10 \text{ pF}$
Rise time	$t_R$		3	10	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 10 \text{ pF}$
Fall time	$t_F$		3	10	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 10 \text{ pF}$

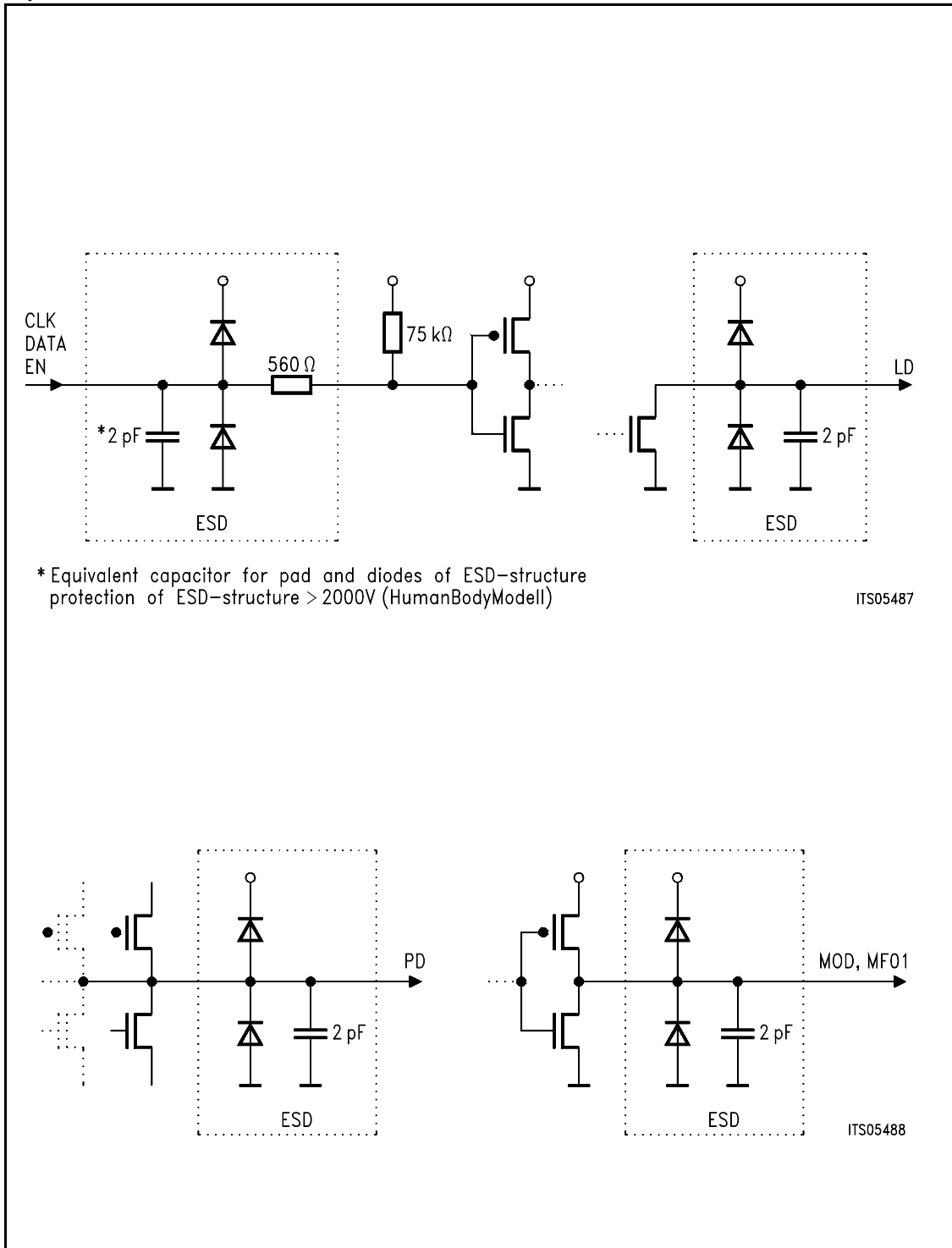
### Output Signal LD (n-channel open drain)

L-output voltage	$V_{QL}$			0.4	V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QL} = 0.5 \text{ mA}$
L-output voltage	$V_{QL}$			0.4	V	$V_{DD} = 3.3 \text{ V}$ , $I_{QL} = 0.5 \text{ mA}$
Fall time	$t_F$		3	10	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 10 \text{ pF}$
Fall time	$t_F$		4.5	10	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 10 \text{ pF}$

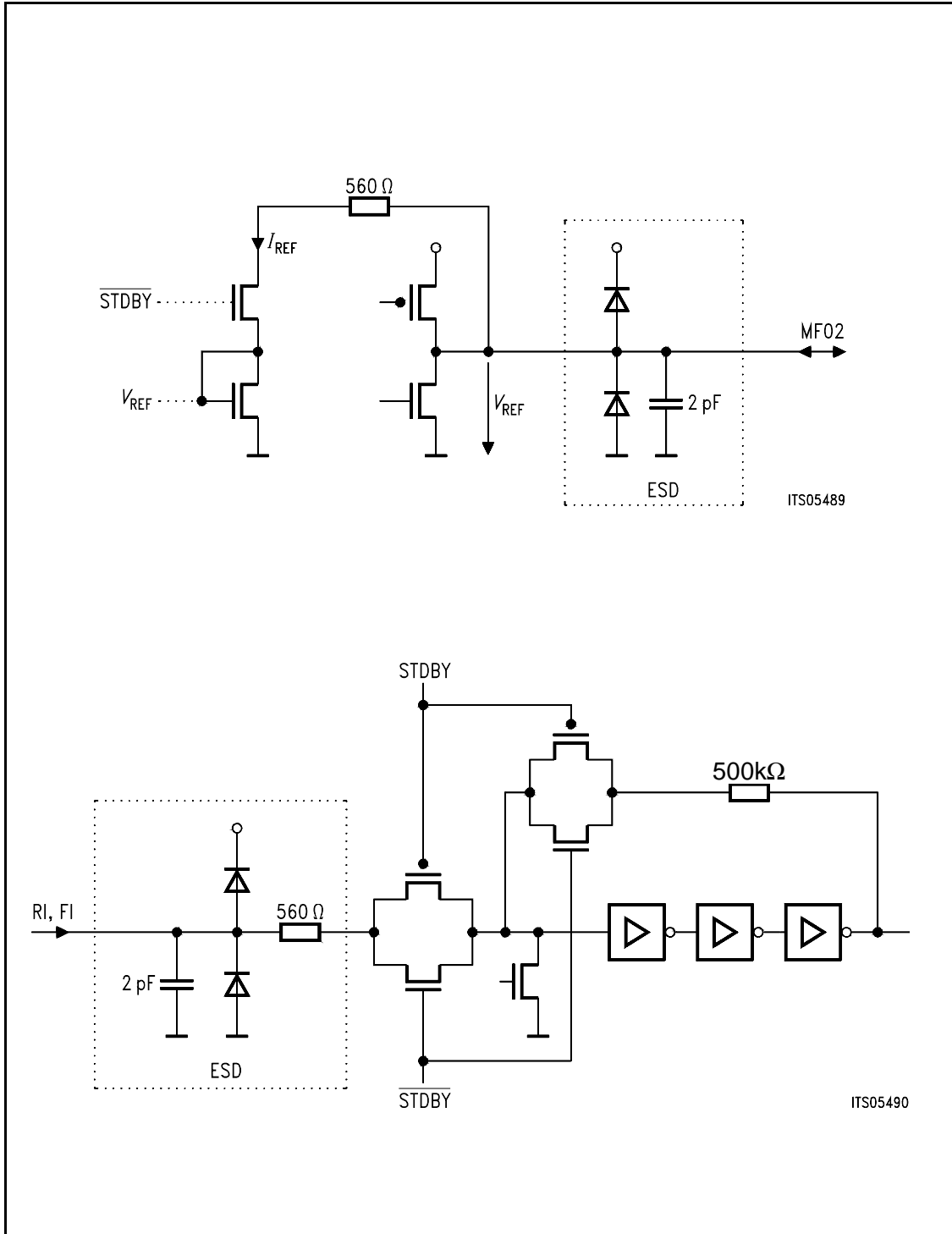
## Electrical Characteristics

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
<b>Output Signal MOD (push-pull)</b>						
H-output voltage	$V_{QH}$	$V_{DD}$ - 0.4			V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QH} = 0.5 \text{ mA}$
L-output voltage	$V_{QL}$			0.4	V	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $I_{QL} = 0.5 \text{ mA}$
H-output voltage	$V_{QH}$	$V_{DD}$ - 0.4			V	$V_{DD} = 3.3 \text{ V}$ , $I_{QH} = 0.3 \text{ mA}$
L-output voltage	$V_{QL}$			0.4	V	$V_{DD} = 3.3 \text{ V}$ , $I_{QL} = 0.3 \text{ mA}$
Rise time	$t_R$		1.5	3	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 5 \text{ pF}$
Fall time	$t_F$		1.3	3	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 5 \text{ pF}$
Propagation delay time H-L to FI	$t_{DQHL}$		8	12	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 5 \text{ pF}$
Propagation delay time L-H to FI	$t_{DQLH}$		8	12	ns	$V_{DD} = 4.5 \dots 5.5 \text{ V}$ , $C_1 = 5 \text{ pF}$
Rise time	$t_R$		2.8	4	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 5 \text{ pF}$
Fall time	$t_F$		1.6	4	ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 5 \text{ pF}$
Propagation delay time H-L to FI	$t_{DQHL}$		12		ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 5 \text{ pF}$
Propagation delay time L-H to FI	$t_{DQLH}$		12		ns	$V_{DD} = 3.3 \text{ V}$ , $C_1 = 5 \text{ pF}$

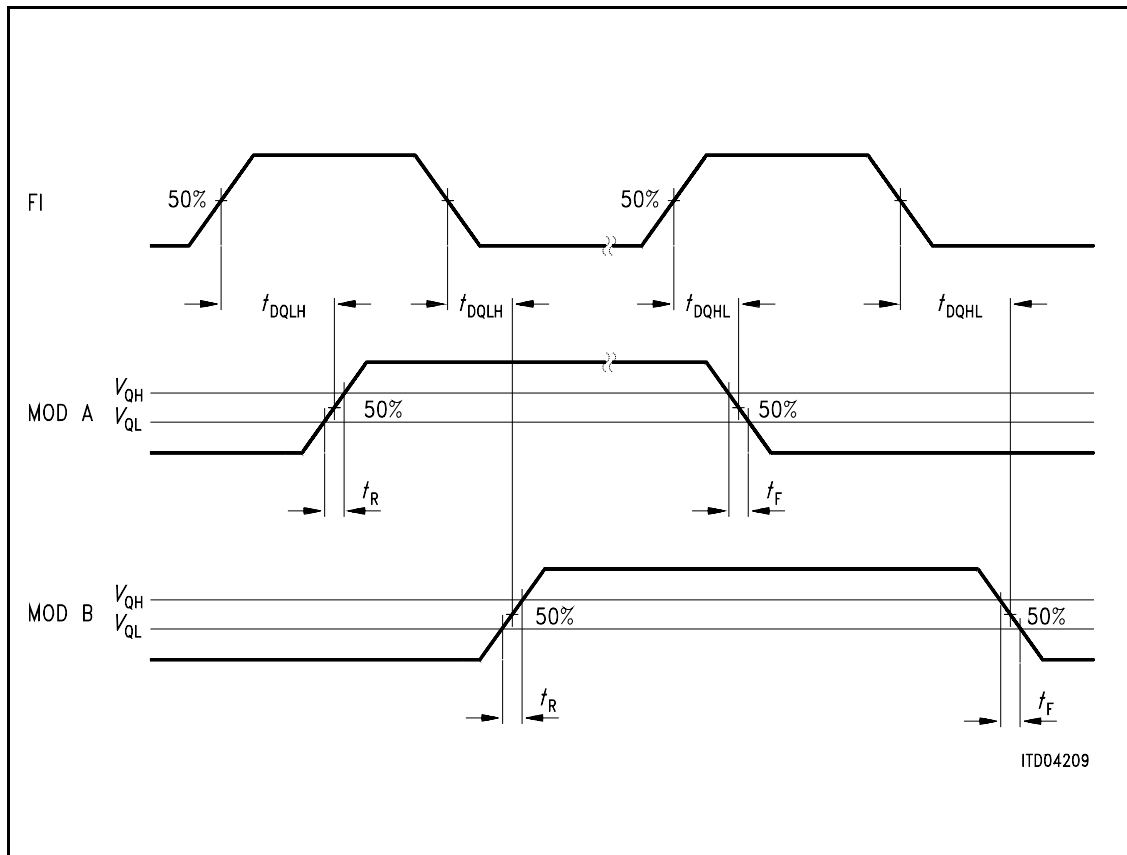
Equivalent I/O Schematics



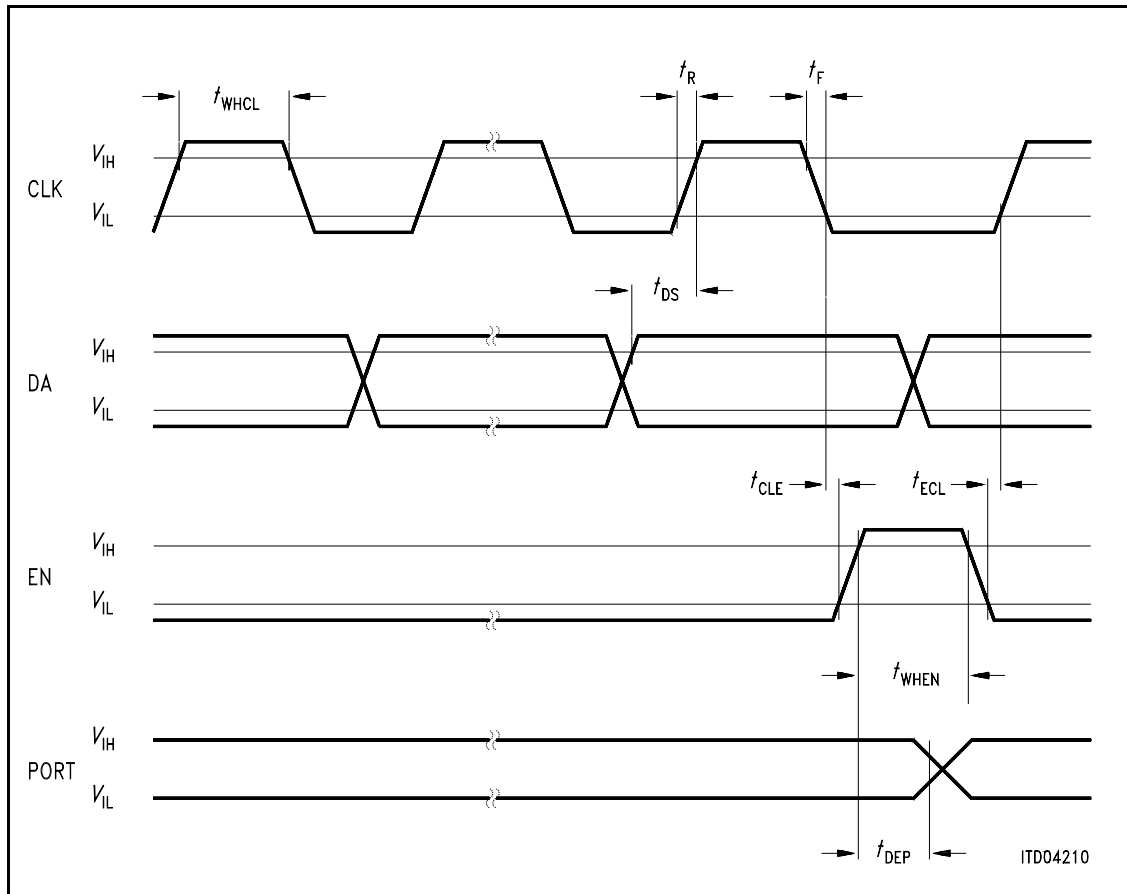
Equivalent I/O Schematics (cont'd)





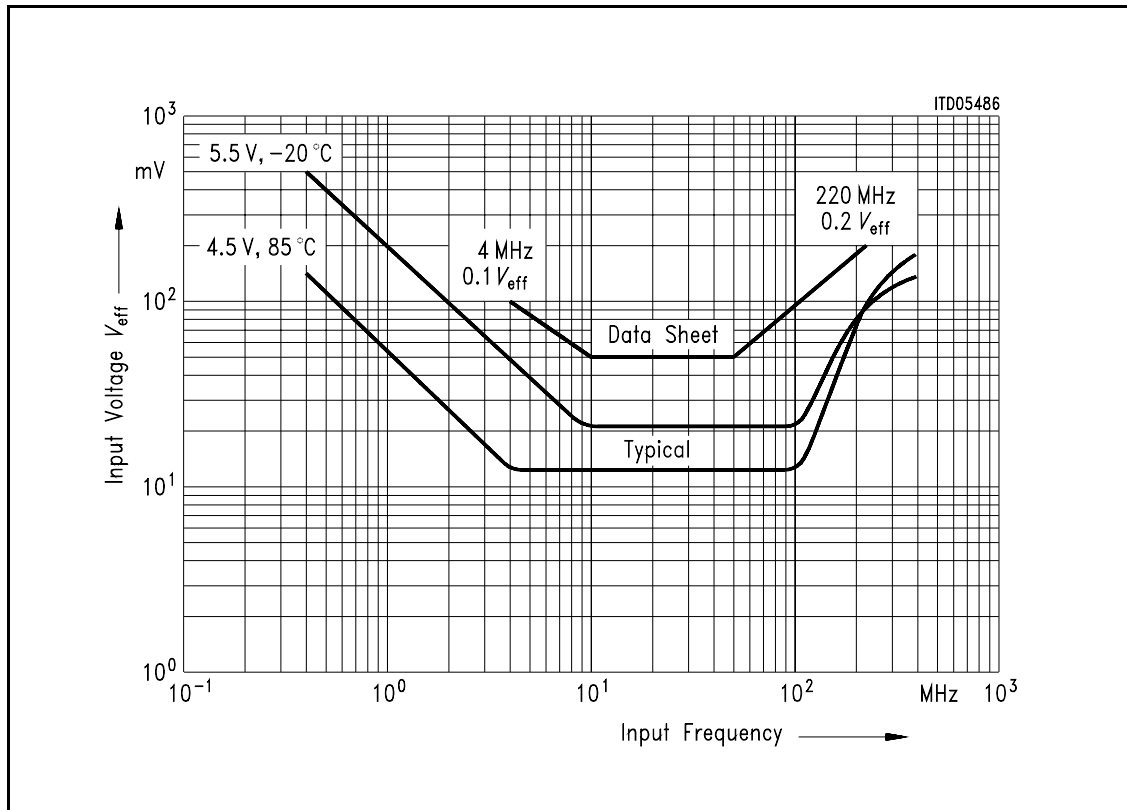


**Pulse Diagram**

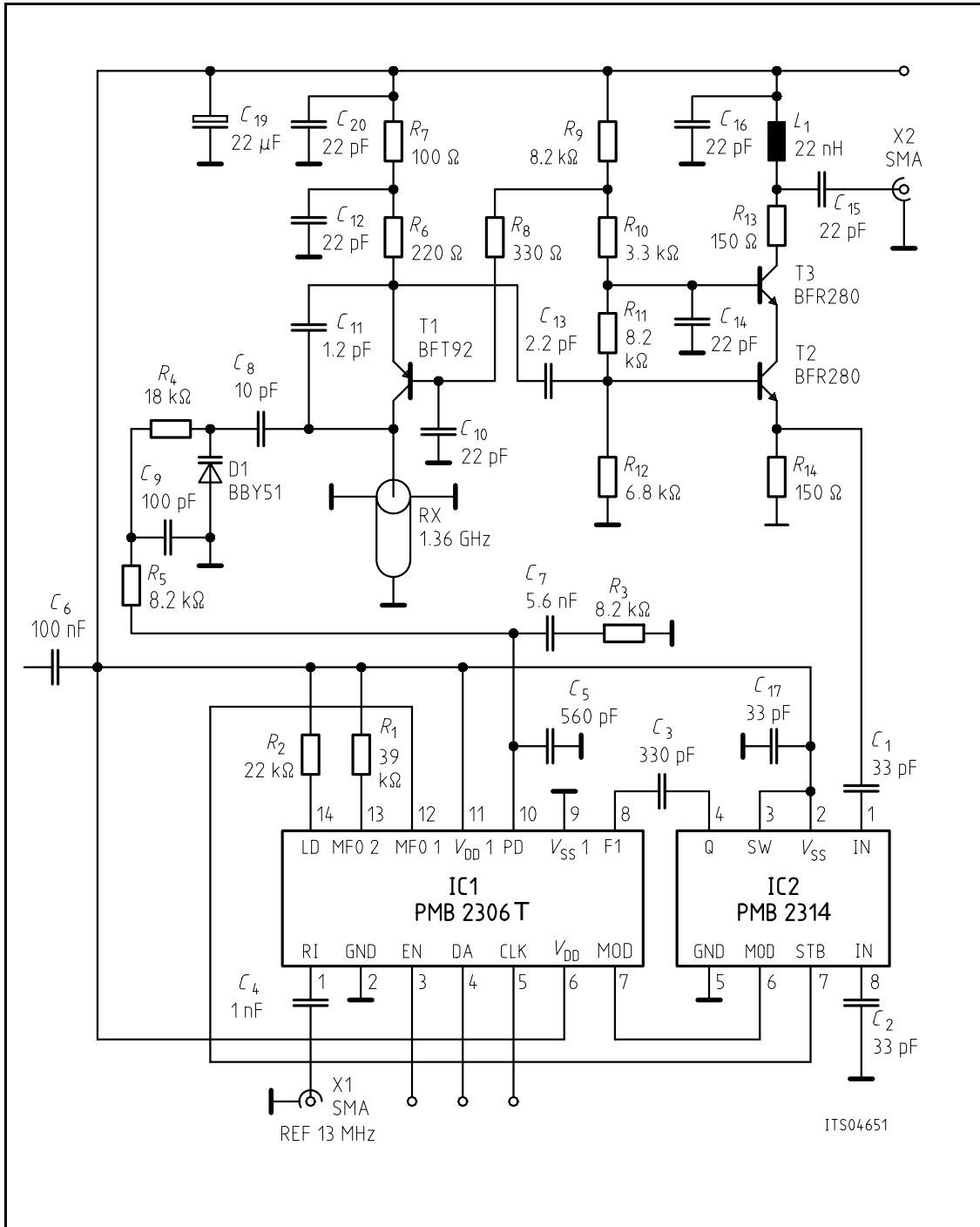


Serial Control Data Input Timing

Parameter	Symbol	Limit Values		Unit	Test Condition
		min.	max.		
Clock frequency	$f_{CL}$		12	MHz	$V_{DD}=3.3V$
H-pulsewidth (CL)	$t_{WHCL}$	40		ns	
Data setup	$t_{DS}$	20		ns	
Setup time clock-enable	$t_{CLE}$	20		ns	
Setup time enable-clock	$t_{ECL}$	20		ns	
H-pulsewidth (enable)	$t_{WHEN}$	40		ns	
Rise, fall time	$t_R, t_F$		10	$\mu s$	
Propagation delay time EN-PORT	$t_{DEP}$		1	$\mu s$	



Input Sensitivity Signal FI (single HF-mode)



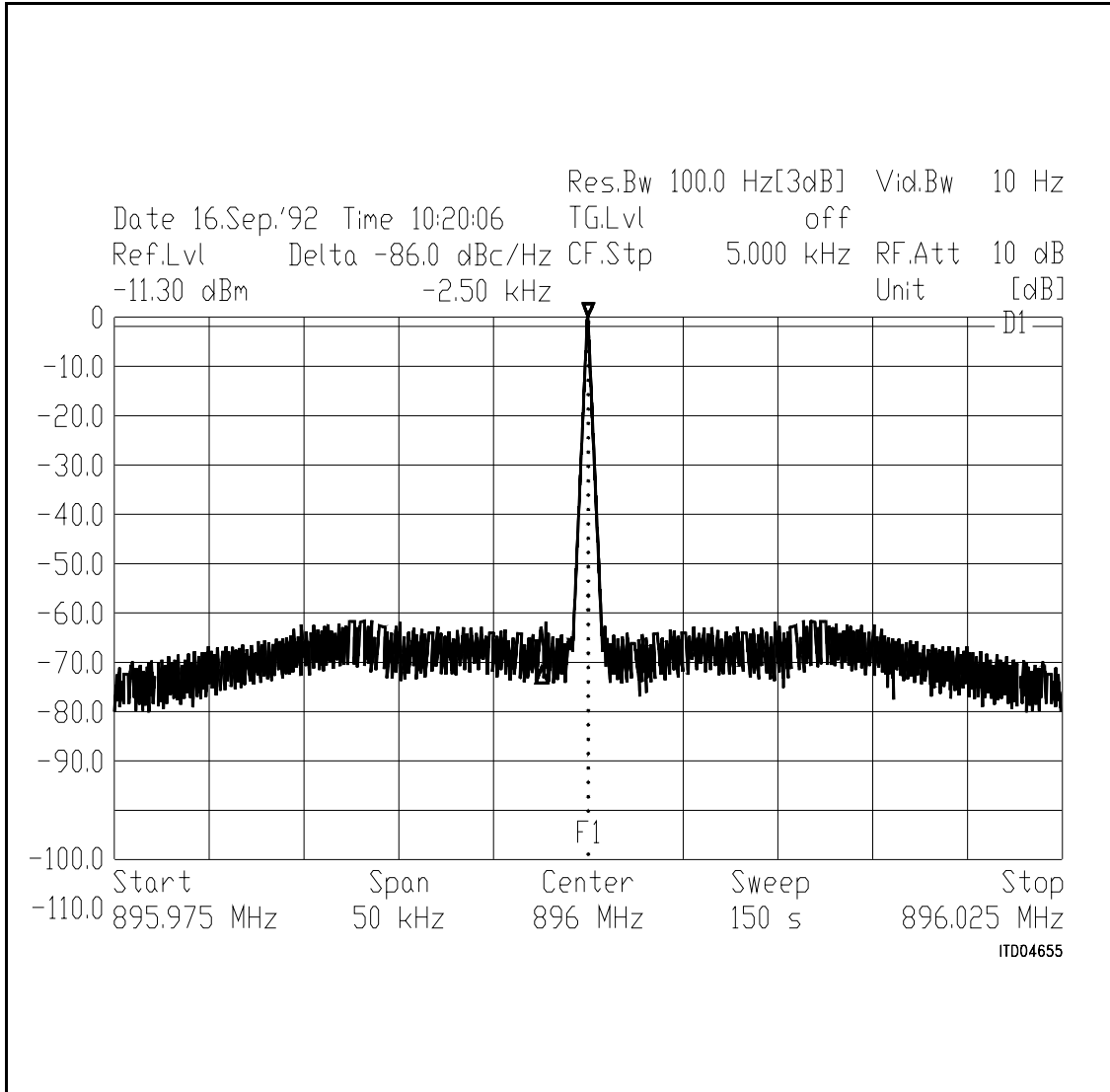
GSM Application Circuit

### Electrical Characteristics

#### List of Components

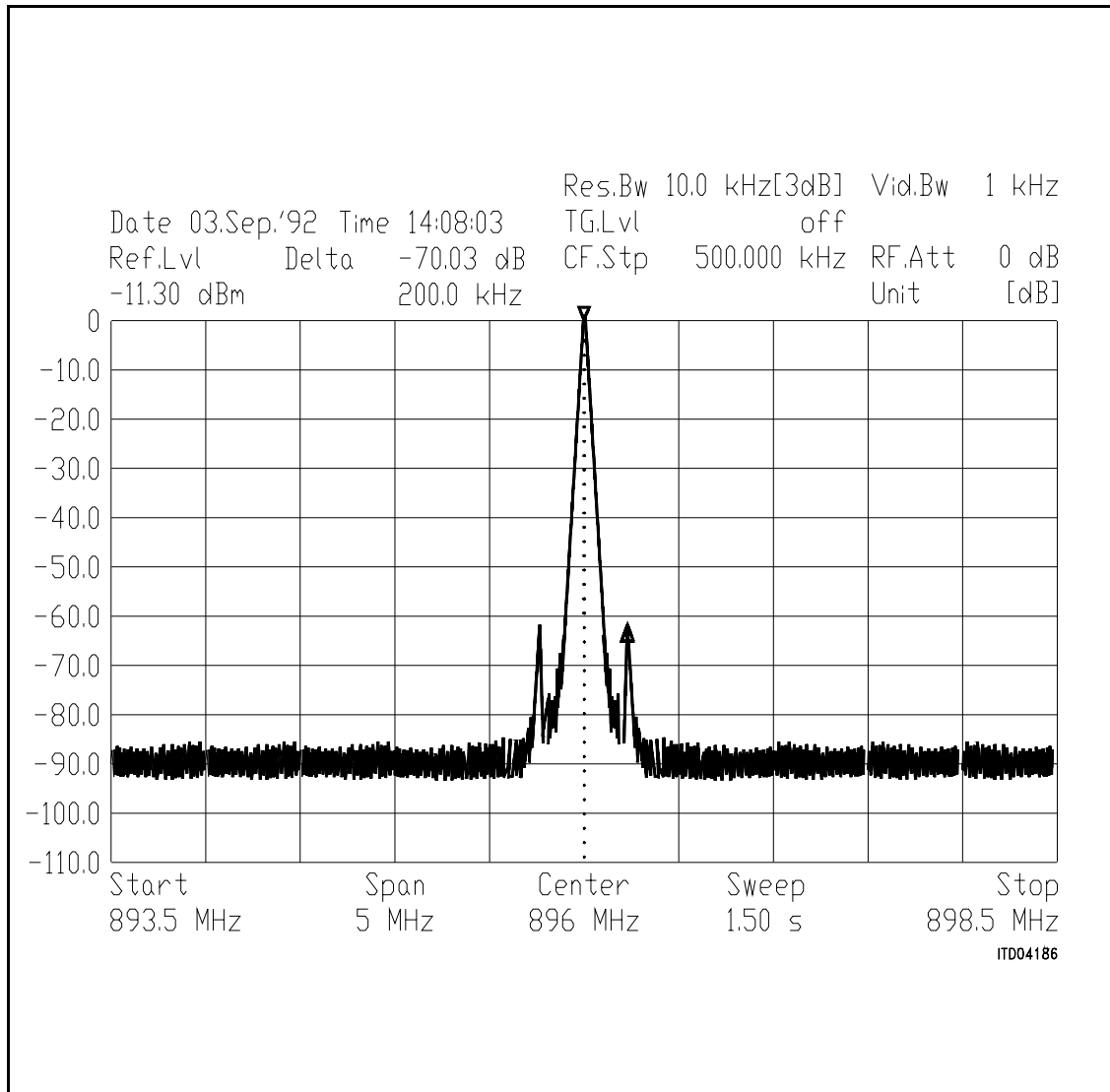
Item	Quantity	Reference		Part	
1	1	$R_7$	100 $\Omega$	SMD/0805 B54102-A1101-K60	S+M
2	2	$R_{13}, R_{14}$	150 $\Omega$	SMD/0805 B54102-A1151-J60	S+M
3	1	$R_6$	220 $\Omega$	SMD/0805 B54102-A1221-J60	S+M
4	1	$R_8$	330 $\Omega$	SMD/0805 B54102-A1331-J60	S+M
5	1	$R_{10}$	3.3 k $\Omega$	SMD/0805 B54102-A1332-J60	S+M
6	1	$R_{12}$	6.8 k $\Omega$	SMD/0805 B54102-A1682-J60	S+M
7	4	$R_9, R_3, R_5, R_{11}$	8.2 k $\Omega$	SMD/0805 B54102-A1822-J60	S+M
8	1	$R_4$	18 k $\Omega$	SMD/0805 B54102-A1183-J60	S+M
9	1	$R_2$	22 k $\Omega$	SMD/0805 B54102-A1223-J60	S+M
10	1	$R_2$	39 k $\Omega$	SMD/0805 B54102-A1393-J60	S+M
11	1	$L_1$	22 nH	SIMID 01 B82412-A3220-M	S+M
12	1	$C_{11}$	1.2 pF	COG/0805 B37940-K5010-C262	S+M
13	1	$C_{13}$	2.2 pF	COG/0805 B37940-K5020-C262	S+M
14	1	$C_8$	10 pF	COG/0805 B37940-K5100-J62	S+M
15	6	$C_{20}, C_{10}, C_{12}, C_{14}, C_{15}, C_{16}$	22 pF	COG/0805 B37940-K5220-J62	S+M
16	3	$C_{17}, C_1, C_2$	33 pF	COG/0805 B37940-K5330-J62	S+M
17	1	$C_9$	100 pF	COG/0805 B37940-K5101-J62	S+M
18	1	$C_3$	330 pF	COG/0805 B37940-K5331-J62	S+M
19	1	$C_5$	560 pF	COG/0805 B37940-K5561-J62	S+M
20	1	$C_7$	5.6 nF	COG/1210 B37949-K5562-J62	S+M
21	1	$C_6$	100 nF	X7R/1210 B37950-K5104-K62	S+M
22	1	$C_{19}$	22 $\mu$ F	B45196-E3226-+409	S+M
23	1	D1	BBY 51	Q62702-B631	SIEMENS
24	2	T3, T2	BFR 280	Q62702-F1298	SIEMENS
25	1	T1	BFT 92	Q62702-F1062	SIEMENS
26	1	$C_4$	1,0 nF	COG/1210 B37949-K5102-J62	S+M
27	2	X2, X1	SMA	Connector	
28	1	RX	1.3 GHz	B69610-G1307-A412	S+M
29	1	IC1	PMB 2306T P-DSO-14	Q67100-H6423	SIEMENS
			PMB 2306T P-DSO-14	Q67106-H6423(T+R)	SIEMENS
30	1	IC2	PMB 2314 P-DSO-8	Q67000-A6121	SIEMENS
			PMB 2314 P-DSO-8	Q67006-A6121(T+R)	SIEMENS

**Electrical Characteristics**



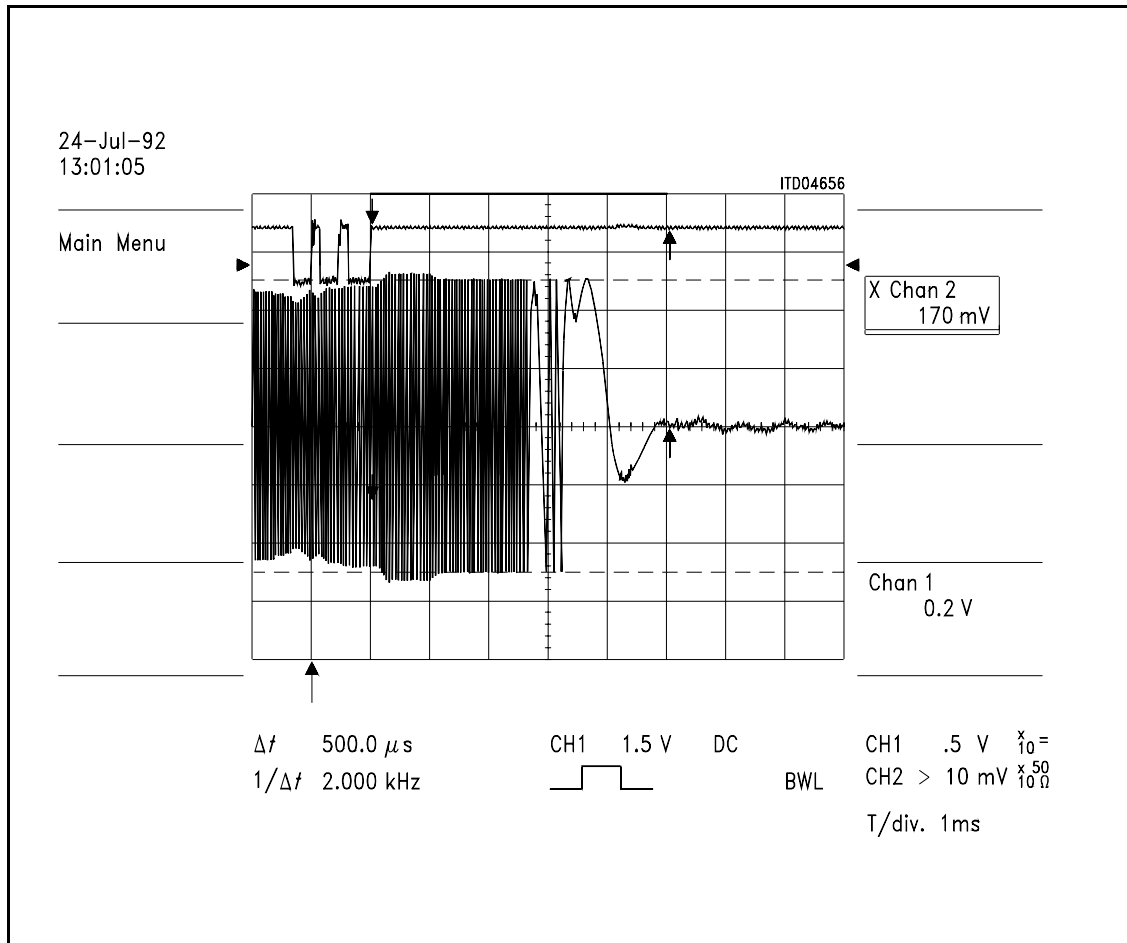
**Phase Noise Close to the Carrier**

### Electrical Characteristics



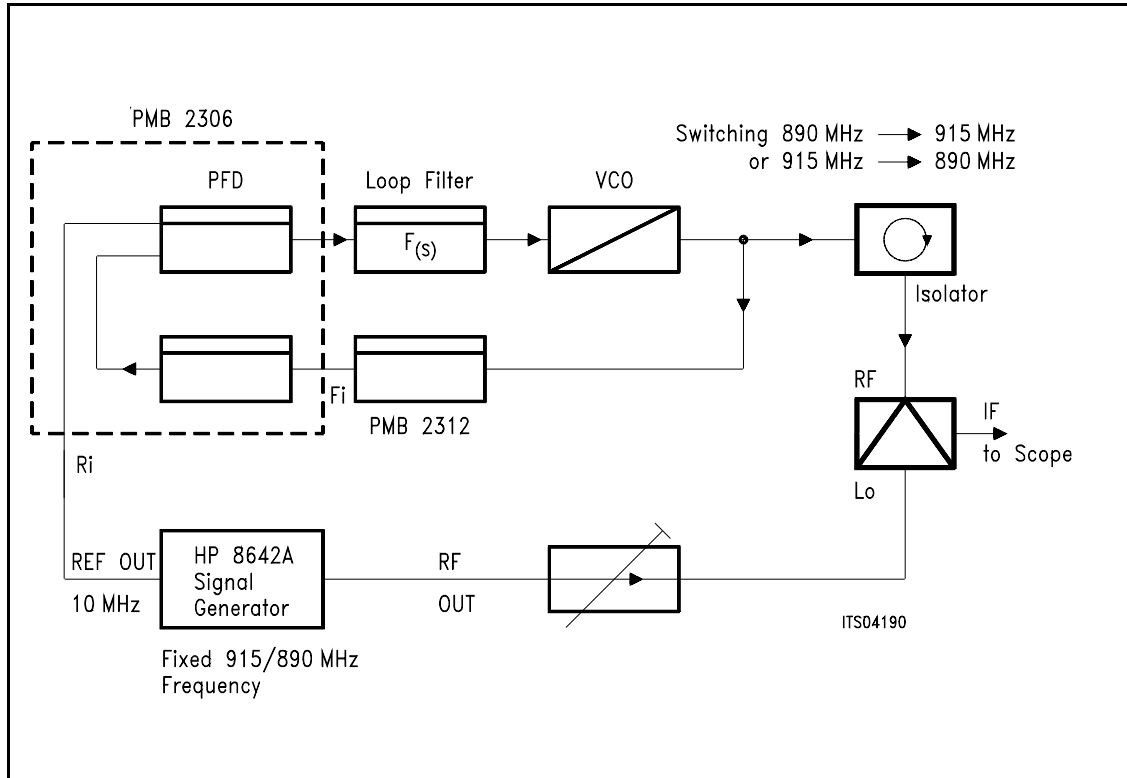
**Spectrum at Lower End of GSM TX Board (Mobile)**

Electrical Characteristics



Lock-In Time for GSM Application

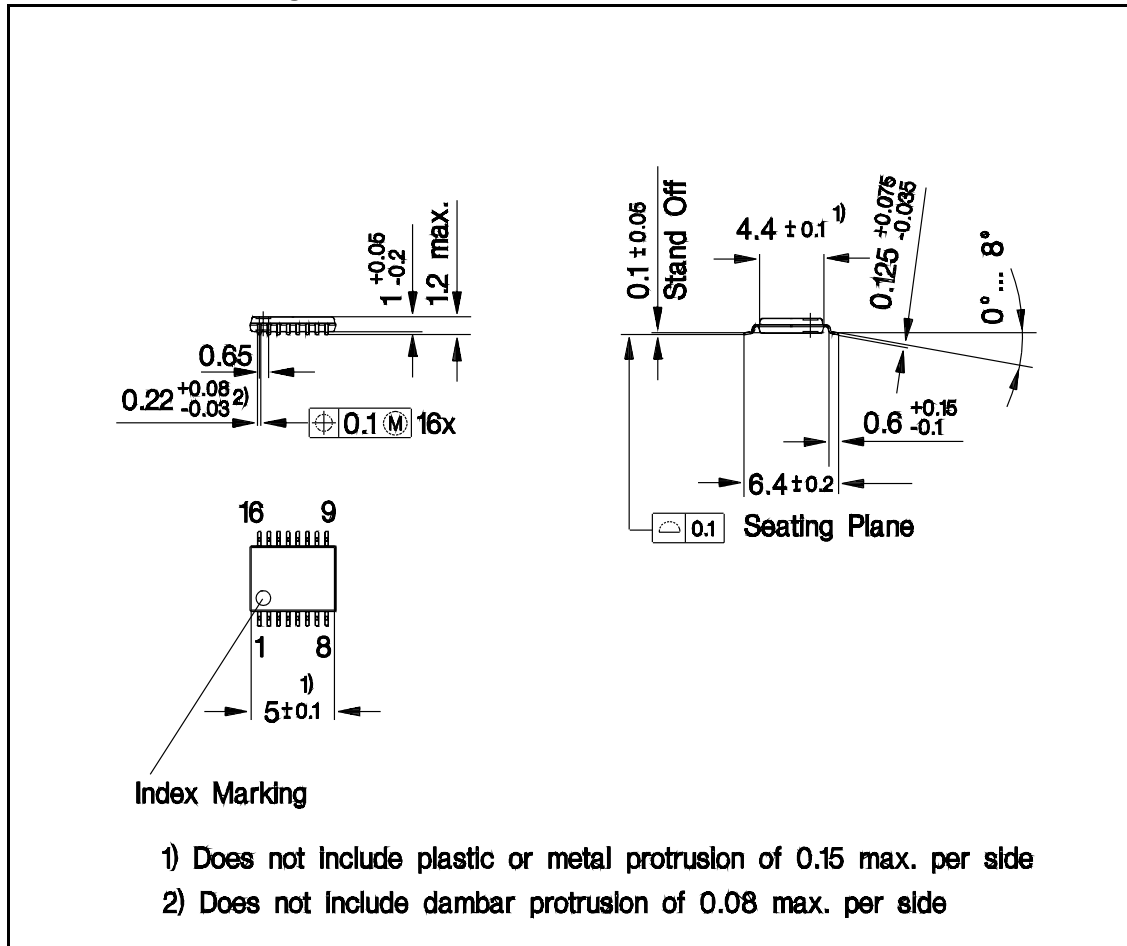




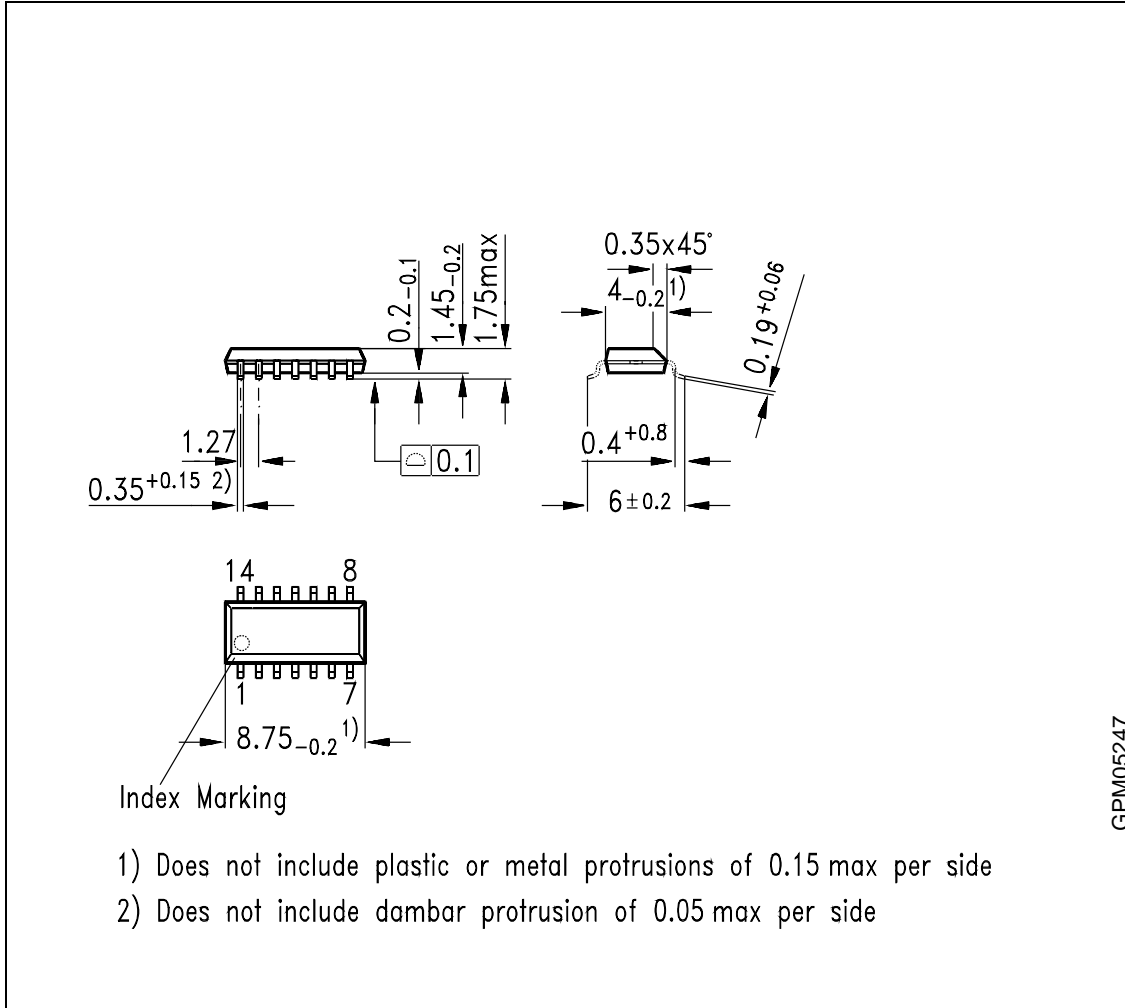
**Measurement Set-Up for Lock- In Time**

### 4 Package Outlines

#### 4.1 Plastic-Package, P-TSSOP-16



4.2 Plastic-Package, P-DSO-14-1(SMD)



GPM05247

**Sorts of Packing**

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm