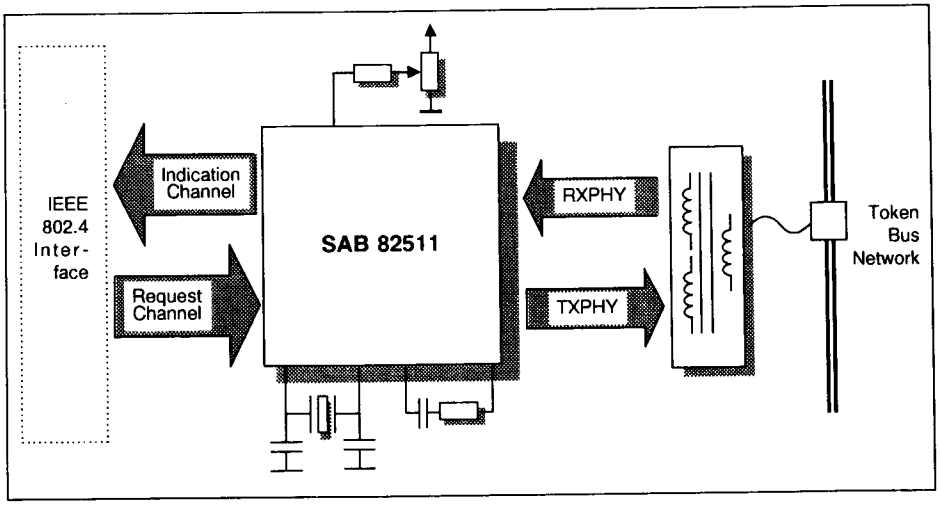
SIEMENS

Token Bus Modem (TBM) SAB 82511

Advanced Information

- Carrier-band modem fully compatible with IEEE 802.4 and MAP Standard
- 5 and 10 Mbit/s data rate using phase-coherent FSK modulation
- Digital PLL and digital demodulation
- Diagnostic loop-back for test purposes
- Provides physical station management
- Jabber inhibit timer (watchdog)
- Differential input/output drivers to serial line
- No active external components
- Advanced Siemens oxid-isolated bipolar technology
- Single +5 V power supply



The token bus modem is designed to work directly with a token bus controller in IEEE 802.4 token bus applications. It uses phase-coherent frequency shift keying modulation at a data rate of 5 Mbit/s and 10 Mbit/s.
The major functions of the modem are to generate the receive and transmit clock, modulate and demodulate (frequency shift keying) and provide the electrical interface to the transceiver cable.

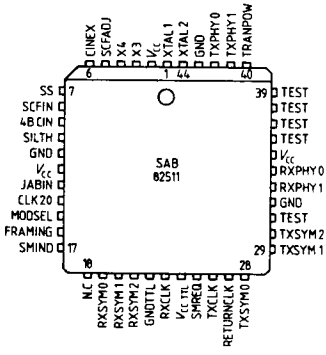
Diagnostic loop-back control enables the modem to route the signal to be transmitted from the token bus controller through the encoding and decoding circuitry and back to the token bus controller. The combined loop-back capabilities of the token bus controller and the token bus modem result in efficient fault detection. An on-chip failsafe watchdog timer circuit prevents the station from locking up in continuous transmit mode.

Ordering Information

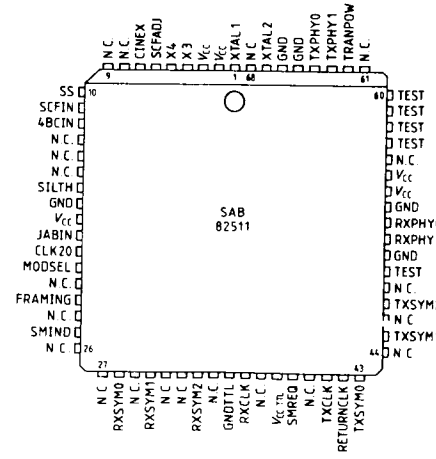
Type	Ordering code	Package	Description
SAB 82511-5-N	Q67020-P51	PL-CC-44	Token bus modem
SAB 82511-1-N	Q67020-P55	PL-CC-44	Token bus modem
SAB 82511-5-NE	Q67020-P57	PL-CC-68	Token bus modem
SAB 82511-1-NE	Q67020-P58	PL-CC-68	Token bus modem

Pin Configurations

PL-CC-44



PL-CC-68



Pin Definitions and Functions

The modem pins are divided into six functional groups:

- Request Channel
- Indication Channel
- Medium Interface
- Operational Mode Selection
- External Clocking
- Power Supply and External Components

All TTL inputs are driven high by internal pullups if not connected.

Symbol	Pin PL-CC-44	Pin PL-CC-68	Input (I) Output (O)	Function
Request Channel				
SMREQ	25	39	I	Selects either MAC mode or Station Management mode (MAC mode = 1)
TXSYM2 TXSYM1 TXSYM0	30 29 28	47 45 43	I	Encoded MAC-symbols for transmission or Station Management requests
TXCLK	26	41	O	Transmit clock provided by the modem (5 MHz or 10 MHz)
RETURNCLK	27	42	I	Transmit clock derived from TXCLK
Indication Channel				
SMIND	17	25	O	Indicates either MAC mode or Station Management mode (MAC mode = 1)
RXSYM2 RXSYM1 RXSYM0	21 20 19	33 30 28	O	Encoded MAC-symbols for reception or Station Management indications and confirmations
RXCLK	23	36	O	Receive clock provided by the modem (5 MHz or 10 MHz)
Medium Interface				
RXPHY0 RXPHY1	34 33	52 51	I	Differential receiver input lines from the medium transformer
TXPHY0 TXPHY1	42 41	64 63	O	Differential transmitter output lines to the medium transformer

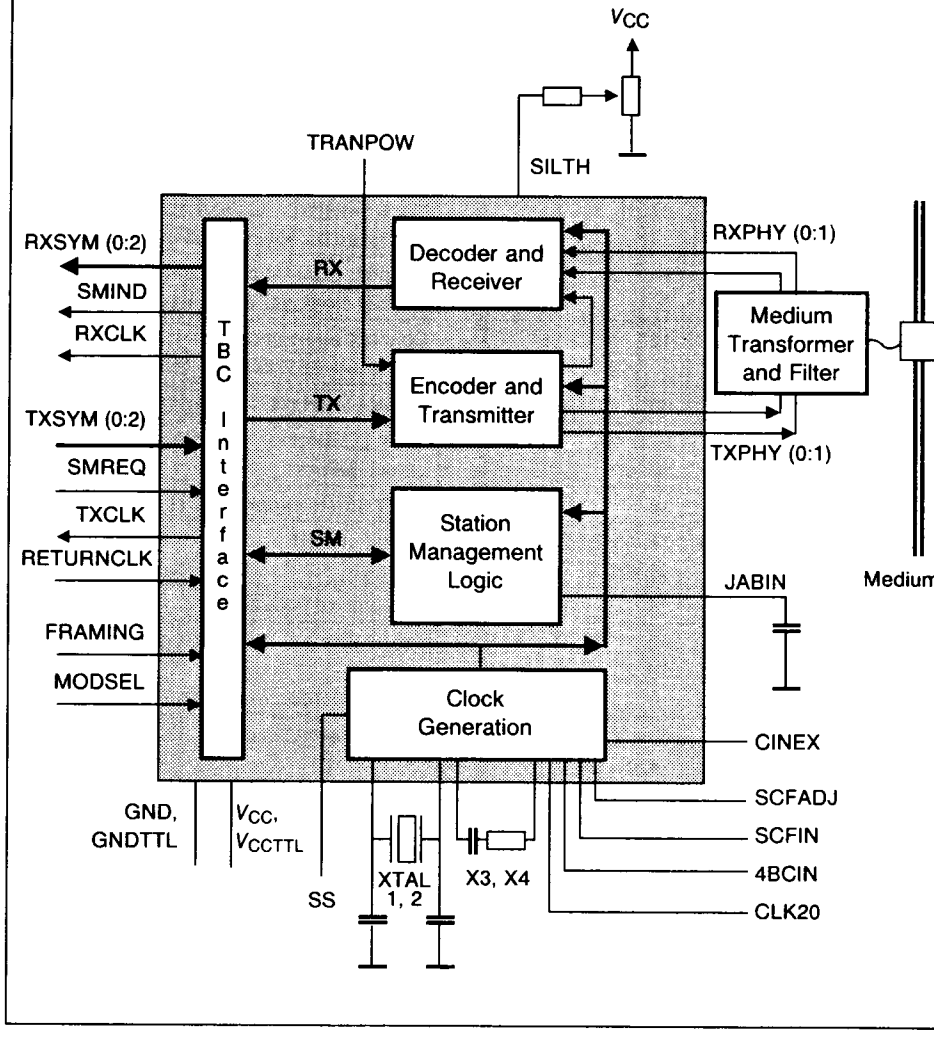
Pin Definitions and Functions (cont'd)

Symbol	Pin PL-CC-44	Pin PL-CC-68	Input (I) Output (O)	Function
Operational Mode Selection				
MODSEL	15	21	I	Enables modem to react to MAC and Station Management requests (Enable: MODSEL = 1). If the modem is disabled (MODSEL = 0) it transmits silence. The indication channel is not influenced by the MODSEL-pin
SS	7	10	I	Selects data rate (10 MHz : SS = 1)
FRAMING	16	23	I	If FRAMING is low the modem will react to MAC and Station Management requests. If FRAMING is high the modem will transmit and indicate silence whatever is requested or received
External Clocking				
CINEX	6	7	I	Selects internal or external clock generator. If CINEX is high, the external clock must be supplied at SCFIN and 4BCIN. If low, the internal clock generator is used, and the SCFIN and 4BCIN-pin should be left open
SCFADJ	5	6	I	Adjusts the asynchronous internal clock, if CINEX is low
SCFIN	8	11	I	External asynchronous clock must be supplied, if CINEX is high. The clock frequency has to be between 16.016 and 16.080 times of the wanted bit frequency
CLK20	14	20	O	20 MHz TTL output of internal clock generator
4BCIN	9	12	I	External clock of 4 times the wanted bit frequency must be supplied, if CINEX is high (tolerance ± 0.01 %)

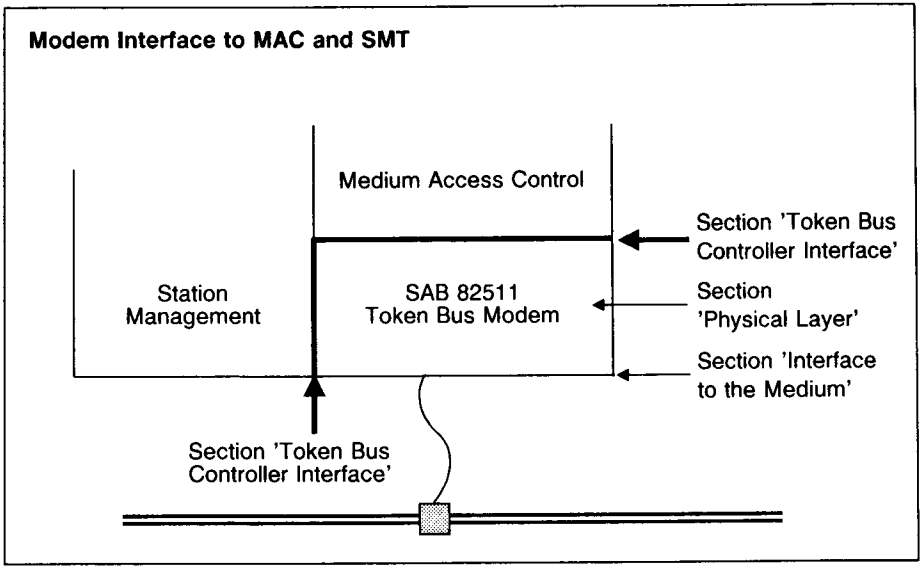
Pin Definitions and Functions (cont'd)

Symbol	Pin PL-CC-44	Pin PL-CC-68	Input (I) Output (O)	Function
Power Supply and External Components				
SILTH	10	16	I	Silence Threshold. This pin isused to adjust the threshold of silence recognition with a resistor
XTAL1 XTAL2	1 44	1 67	I	Connect 20 MHz crystal to use internal clock generator. Instead an external 20 MHz clock can be AC-coupled to XTAL2
X3 X4	3 4	4 5	I	Connect external capacitor and resistor for internal clock generator operation
JABIN	13	19	I	Connect external capacitor to ground to define JABBER INHIBIT time
TRANPOW	40	62	I	Adjusts transmitter output level
V_{CC}	2, 12, 35	2, 3, 18, 54, 55	–	+ 5 V power supply for digital logic and output drivers
V_{CCTTL}	24	38	–	+ 5 V power supply for TTL logic
GND	11, 32, 43	17, 50, 53, 65, 66	–	Circuit ground
GNDTTL	22	35	–	TTL ground potential
TEST	31, 36, 37, 38, 39	49, 57,58, 59, 60	–	These pins are reserved an must be left open. No connections are allowed
NC	18	8, 9, 13, 14, 15, 22, 24, 26, 27, 29, 31, 32, 34, 37, 40, 44, 46, 48, 56, 61, 68	–	Not connected internal

Block Diagram



Token Bus Controller Interface



The interface (see figure above) provides the means for transferring information between the modem and the medium access control (MAC) and between the modem and the station management. In the interest of minimizing the number of signal lines, the station management uses the same lines as the MAC to access the modem. The interface supports three primary functions as described below:

Request Channel MAC Mode

The MAC mode is selected when SMREQ = 1 and is considered "normal" operation. The MAC defines 5 symbols for transmission: silence, non-data, one, zero and pad-idle (see next table). The MAC sends these symbols on lines TXSYM0, TXSYM1 and TXSYM2 to the modem. The modem modulates its transmit carrier signal accordingly. These requests are synchronized to RETURNCLK.

MAC request symbol encoding

	SMREQ	TXSYM2	TXSYM1	TXSYM0
Silence	1	1	1	Don't Care
Non-Data	1	1	0	Don't Care
Pad-Idle	1	0	1	Don't Care
One	1	0	0	1
Zero	1	0	0	0

Indication Channel MAC Mode

The MAC mode is indicated by SMIND = 1. The MAC defines 5 symbols for data reception: silence, non-data, bad-signal, one and zero (see next table). The modem reports these symbols on lines RXSYM0 – RXSYM2 to the MAC, synchronized to RXCLK.

MAC indication symbol encoding

	SMIND	RXSYM2	RXSYM1	RXSYM0
Silence	1	1	1	X
Non-Data	1	1	0	X
Bad-Signal	1	0	1	X
One	1	0	0	1
Zero	1	0	0	0

X = either 0 or 1

Physical Layer Management

The request channel and the indication channel serve a second purpose which is to pass station management requests to the modem and to pass station management confirmations and indications to the station management.
Serial commands are not supported.

Management Request

The management mode is selected by SMREQ = 0. The request channel is used by the station management to send station management requests to the modem (for encoding see table below).
The modem must be enabled by MODSEL. All unused commands are not supported.

Note: The transmitter is disabled whenever the modem is in management mode.

Management request encoding

	SMREQ	TXSYM2	TXSYM1	TXSYM0
RESET	0	1	1	1
LOOP-BACK DISABLE	0	1	0	1
ENABLE TRANSMITTER	0	0	1	1
IDLE/SERIAL DATA	0	0	0	*)

*) TXSYM0 contains a start bit, eight data bits and a stop bit, when the MAC issues a SERIAL DAT/ command. Otherwise, TXSYM0 = 1.

RESET initiates the modem, disables the transmitter and enables the loop-back.

LOOP-BACK DISABLE disables the loop-back at the point closest to the cable between TXPHY and RXPHY.

ENABLE TRANSMITTER switches the transmission path from TXSYM0 – TXSYM2 to the differential output lines to the medium.

IDLE indicates that the MAC layer is waiting.

Management Indication/Confirmation

The management mode is indicated by SMIND = 0. The indication channel is used by the modem to send responses (confirmations) to management commands and to indicate modem fault (PHYSICAL ERROR indication).

The table below shows the encoding for the indication channel management mode. Use of the signal lines is described below.

Management indication/confirmation encoding

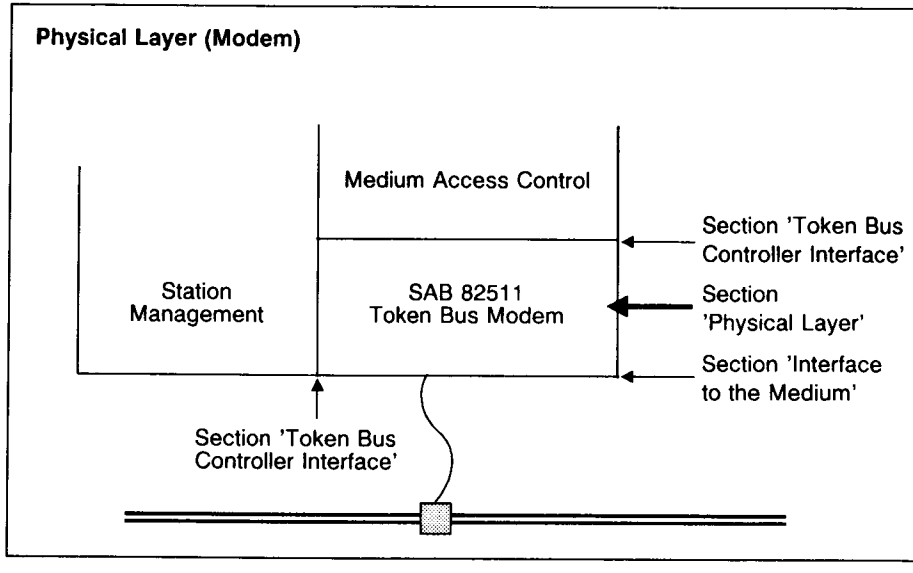
	SMIND	RXSYM2	RXSYM1	RXSYM0
NAK (non-acknowledgement)	0	1	0	*)
ACK (acknowledgement)	0	0	1	1
IDLE	0	0	0	1
PHYSICAL ERROR	0	1	1	1

*) RXSYM0 contains a start bit, "don't care" data and a stop bit, when responding to a serial data command. Otherwise, RXSYM0 = 1.

Management mode (SMIND = 0) is entered in response to SMREQ = 0 as confirmation that the modem has gone to management mode.

Management mode is also entered as a result of a PHYSICAL ERROR condition (indication). For the first case, the modem will enter the management mode (SMIND = 0) after SMREQ goes low and will leave the management mode when SMREQ goes high. For the second case, the modem will enter the management mode and stay there until the station management corrects the error and leaves the management mode.

Physical Layer



Symbol Encoding

When in the MAC mode, the modem transmits symbols received at its MAC interface to the medium. Each of these MAC symbols is encoded into a pair of PHY symbols out of a three-symbol (H), (L), (off) code and then transmitted. The encoding for each of the input MAC symbols is:

(1) Silence Each silence symbol is encoded as the sequence (off off).

(2) Pad-Idle Successive pad-idle symbols are encoded as an alternating series of (LL) and (HH).

(3) Zero Each zero symbol is encoded as the sequence (HH).

(4) One Each one symbol is encoded as the sequence (LL).

(5) Non-Data Non-Data symbols are transmitted by the MAC in pairs. Each such pair of consecutive non-data symbols is encoded as the sequence (HL, LH).

Line Signal (at the line output of the modem)

The PHY symbols resulting from the symbol encoding are converted directly to their line representation, as described below, and the resulting signaling is AC-coupled to the single channel phase-coherent FSK bus medium. The modem is able to receive signals of either polarity.

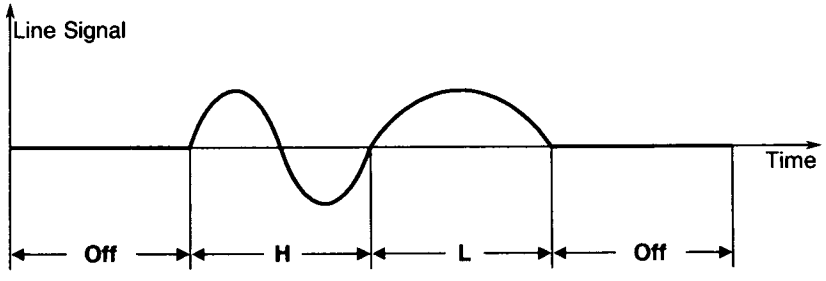
The line signal representation of the (H), (L) and (off) PHY symbols is as follows (see also figure below):

(1) An (H) is represented as one full cycle of a signal starting and ending with a nominal zero amplitude, the period of which is equal to half the period of MAC symbol delivery to the MAC entity at the MAC interface.

(2) An (L) is represented as one half cycle of a signal, starting and ending with a nominal zero amplitude, the period of which is equal to the period of MAC symbol delivery to the MAC entity at the MAC interface, with the phase of the representing half cycle changing at each successive (L).

(3) An (off) is represented by no signal for a period equal to one half of the period of MAC symbol delivery to the MAC entity at the MAC interface.

Symbolic Line Signal Representation

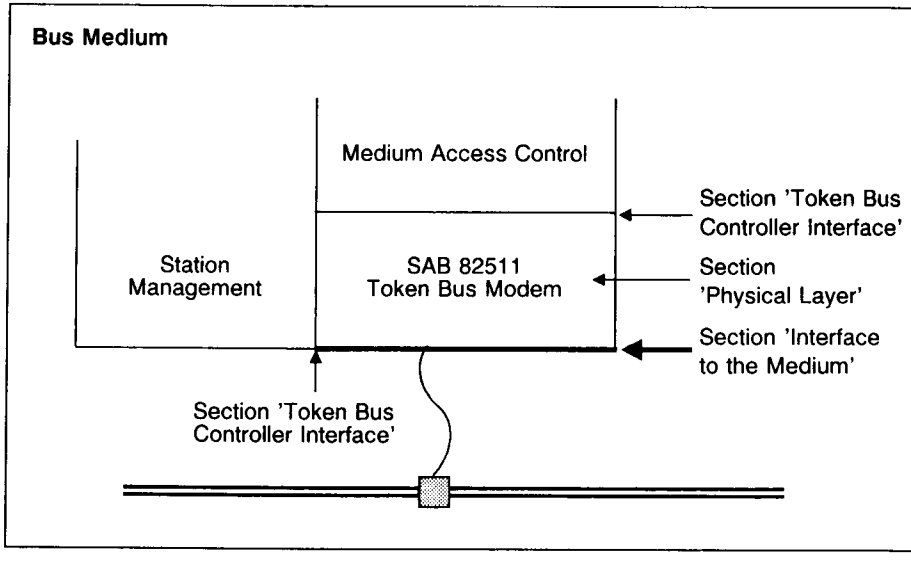


The maximum jitter in the period of any (L) or half-cycle of any (H) is not more than ±1 percent of the MAC symbol period.
The next table summarizes the relationship of data rate and signaling frequencies.

Data Rate vs. Signaling Frequencies

Data Rate (Mbps)	Frequency of Lower Tone (MHz)	Frequency of Higher Tone (MHz)
5	5.0	10.0
10	10.0	20.0

Interface to the Medium



All measurements specified in the following paragraphs are to be made at the point of station or regenerative repeater connection to the medium. Unless otherwise stated, all voltage and power levels specified are in rms and dB (1 mV, 75 Ω) [dBmV] rms, respectively, based on measuring the fundamental signal content of continuous transmissions of all 'one' or all 'zero' symbols.

Coupling to the Medium

The connection of the single-channel phase-coherent FSK bus medium to the station should be a flexible 75 Ω drop cable terminated in a male F-series 75 Ω connector; this combination shall match with a female F-series 75 Ω connector mounted on the station. In addition to this coupling, the shield(s) of the coaxial drop cable medium shall be connected to the shell of the terminating male connector and the DC impedance of that connection shall be less than 0.1 Ω. Also the DC impedance of a connection between the shell of that male connector and the outer barrel of a mated female connector shall be less than 0.1 Ω.

Characteristic Impedance

The characteristic impedance of the single-channel phase-coherent FSK bus medium shall be 75 ± 3 Ω. The physical medium shall present an impedance to the station resulting in a VSWR of 1.5:1 or less when driven from a 75 Ω source over the operating frequency range.

Signal Level

When receiving the signal of a single station or regenerative repeater the single channel phase-coherent FSK bus medium shall present that signaling to the connected station or regenerative repeater at an amplitude between +10 dB and +66 dB (1 mV, 75 Ω) [dBmV] for a 5 Mbit/s data rate and a 10 Mbit/s data rate.
The signal strength of the two fundamental signaling frequencies due to media attenuation (corresponding to the data rate and twice the data rate) at any receiving station shall vary by no more than 3.5 dB.

Note: This is equivalent to the cable tilt found on 600 meters of foam dielectric RG-11 type cable with 2 dB / 100 m of attenuation at 10 MHz.

Absolute Maximum Ratings

Ambient temperature under bias	PL-CC-44 (static air)	0 to 55 °C
	PL-CC-44 (moving air 1 m/s)	0 to 70 °C
	PL-CC-68 (static air)	0 to 70 °C
	PL-CC-68 (moving air 1 m/s)	0 to 85 °C
Storage temperature under bias		– 65 to + 150 °C
All TTL output and supply voltages		– 0.5 to V_{CC} + 0.5 V
All Input voltages		– 0.5 to + 5.5 V

Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum ratings for extended periods may affect device reliability.

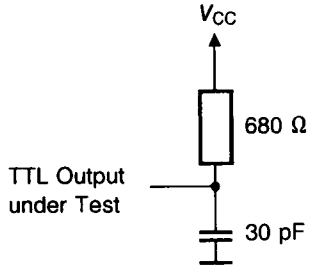
DC Characteristics for TTL Voltages

V_{CC} = + 5 V ± 5 %

Parameter	Symbol	Limit values		Unit	Test conditions
		min.	max.		
Input low voltage	V_{IL}	–	0.8	V	
Input high voltage	V_{IH}	2.0	–	V	
Output low voltage	V_{OL}	–	0.5	V	at 8 mA 1)
Output high voltage	V_{OH}	2.5	–	V	at – 1.0 mA
Output low current	I_{OL}	–	4	mA	1)
Input clamp voltage	V_C	– 1.0	–	V	I_C = – 5 mA
Input low current	I_{IL}	–	– 2	mA	at V_{IL} = 0.5 V
Input high current	I_{IH}	–	50	µA	at V_{IH} = 2.7 V
Power supply current Transmitter off	I_{CC}	–	370	mA	
Foreward input current	I_F	–	– 2	mA	V_F = 0.45 V
Reverse input current	I_R	–	50	µA	$V_R = V_{CC}$ + 0.3 V
Output off current	I_{OFF}	–	I_F	–	V_{OFF} = 0.45 V
Output off current	I_{OFF}	–	I_R	–	$V_{OFF} = V_{CC}$ + 0.3 V
Input capacitance	C_{IN}	–	10	pF	f = 1 MHz V_{CC} = 5 V T_A = 25 °C V_{BIAS} = 2.5 V

1) Pin CLK20 at 2 mA.

TTL Output Test Load Circuit



AC Characteristics

V_{CC} = +5 V ±5 %

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
DCE / DTE Interface (5 Mbit/s)					
RXCLK period	t_{60a}	180	200	220	ns
TXCLK period	t_{60b}	180	200	220	ns
RXCLK sum of 3 periods	t_{61}	540	600	660	ns
RXCLK/TXCLK low time	t_{62}	80	100	120	ns
RXCLK/TXCLK high time	t_{63}	80	100	120	ns
RXCLK/TXCLK rise/fall time (10 % - 90 %)	t_{64}	–	–	10	ns
RETURNCLK/TXSYM/SMREQ setup time	t_{65}	70	–	–	ns
RETURNCLK/TXSYM/SMREQ hold time	t_{66}	10	–	–	ns
RXSYM/SMIND setup time to RXCLK	t_{67}	80	–	–	ns
RXSYM/SMIND hold time from RXCLK	t_{68}	10	–	–	ns
RXCLK period when reporting silence or bad signal	t_{60}	180	–	420	ns
RXCLK sum of 3 periods during synchronization	t_{61}	540	–	860	ns
RXCLK low time during synchronization	t_{62}	80	–	340	ns
RXCLK high time during synchronization	t_{63}	80	–	340	ns

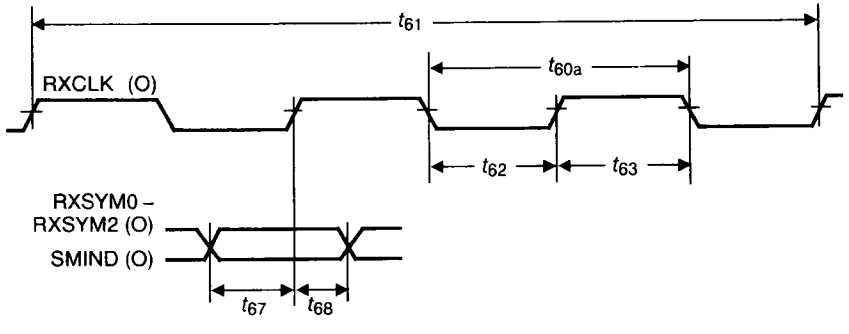
AC Characteristics (cont'd)

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
DCE / DTE Interface (10 Mbit/s)					
RXCLK period	t_{60a}	90	100	110	ns
TXCLK period	t_{60b}	90	100	110	ns
RXCLK sum of 3 periods	t_{61}	270	300	330	ns
RXCLK/TXCLK low time	t_{62}	40	50	60	ns
RXCLK/TXCLK high time	t_{63}	40	50	60	ns
RXCLK/TXCLK rise/fall time (10 % - 90 %)	t_{64}	–	–	10	ns
RETURNCLK/TXSYM/SMREQ setup time	t_{65}	35	–	–	ns
RETURNCLK/TXSYM/SMREQ hold time	t_{66}	10	–	–	ns
RXSYM/SMIND setup time to RXCLK	t_{67}	40	–	–	ns
RXSYM/SMIND hold time from RXCLK	t_{68}	10	–	–	ns
RXCLK period when reporting silence or bad signal	t_{60}	90	–	210	ns
RXCLK sum of 3 periods during synchronization	t_{61}	270	–	430	ns
RXCLK low time during synchronization	t_{62}	40	–	170	ns
RXCLK high time during synchronization	t_{63}	40	–	170	ns

Receiver Characteristics

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Input voltage at RXPHY0 and RXPHY1	V_I	GND	–	V_{CC}	–
Input power for normal receive operation	P_I	10	–	67.5	dBmV
Receiver input capacitance	C_I	–	–	5	pF
Receiver input impedance (within receive band)	$\|Z_I\|$	–	1	–	kΩ
Transmitter output capacitance	C_T	–	–	12	pF
Signal/noise ratio for normal receive operation	SNR	20	–	–	dB

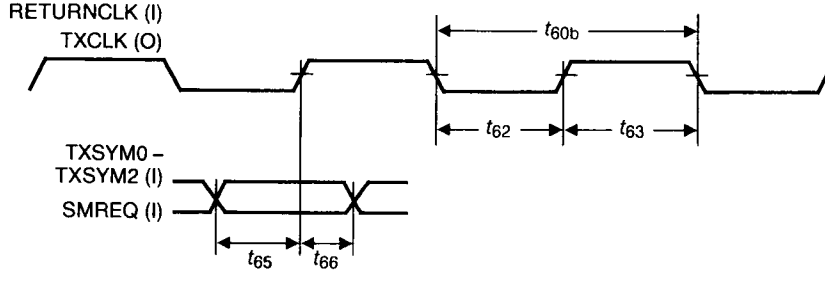
Receive Timing



Transmitter Characteristics

Parameter		Symbol	Limit Values			Unit
			min.	typ.	max.	
Output voltage at TXPHY0 and TXPHY1		V_O	V_{CC} – 2.8	–	V_{CC} + 2.8	V
Output current for transmit operation		I_O	52	–	70	mA
Output power for transmit operation	2)	P_O	63	–	67.5	dBmV
Output current rise time (10 % - 90 %)	3)	t_r	4	–	–	ns
Output current fall time (10 % - 90 %)	3)	t_f	4	–	–	ns

Transmit Timing



2) Adjustable with TRANPOW pin.

3) Thus value is measured at a transmitter output pin, with an ohmic load of 37,5 Ω to V_{CC}. The value will be increased by the use of a transformer and the filters circuitry.