

1. Features and Benefits

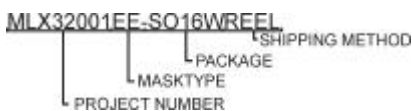
- CLIP / Caller-ID support
- Line status measuring facilities
- Line event registration
- Lightning safe
- Pre-programming of default settings
- Powered by PSTN line (less than 10 μ A power consumption during offline)
- SW programmable for worldwide use

2. Applications

- Analog front-end PSTN interfaces
- DECT base stations
- Low / high speed modems
- Payphones
- PBX / Fax
- PC-Voice and mixed voice/data applications
- Remote configuration / E-pay / POS terminals
- Settop boxes
- Utility meter reading
- VOIP converters on POTS (terminal side)

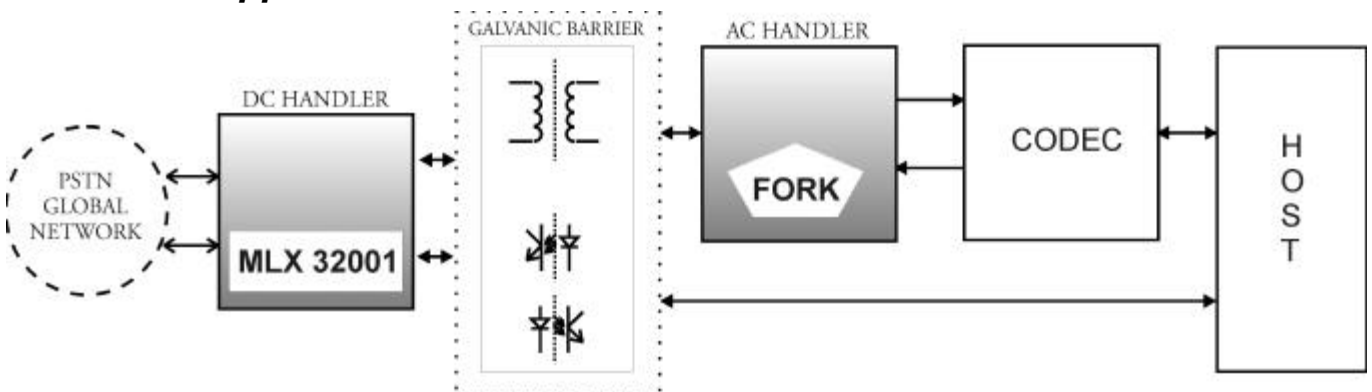
3. Ordering information

<i>Number</i>	<i>Package Description</i>
MLX32001EE-SO16WREEL	Plastic small outline package; 16 leads; body width 300 mil Packed per 1500 pcs REEL
MLX32001EE-SO16WTUBE	Plastic small outline package; 16 leads; body width 300 mil Packed per 22 tubes of 46 pcs / tube = 1012.
MLX32001FA-SO16WREEL	Plastic small outline package; 16 leads; body width 300 mil Packed per 1500 pcs REEL
MLX32001FA-SO16WTUBE	Plastic small outline package; 16 leads; body width 300 mil Packed per 22 tubes of 46 pcs / tube = 1012.

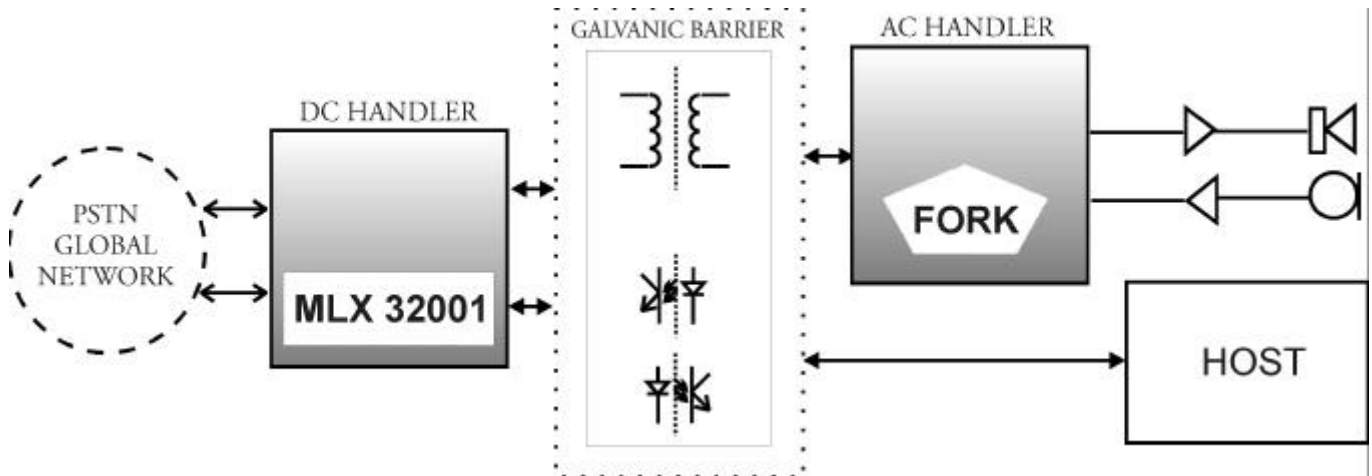


4. Functional Block Diagram

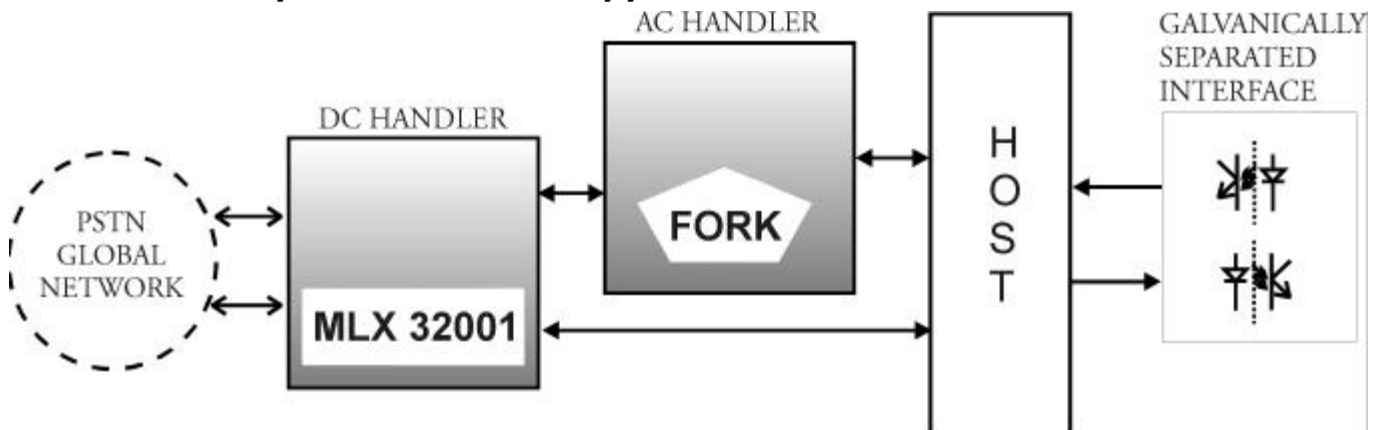
4.1 Modem application



4.2 PC-Voice application



4.3 PSTN Line powered modem application



5. Description

MLX32001 implements the DC-handler of a universal PSTN Line Interface. It is fully telephone line powered and digital control is performed by a special *UARTFLEX*. There is no crystal or resonator linked to MLX32001 and thus the core as well as the UART are capable to adapt themselves to the HOST UART's preferred communication speeds. The synchronisation time of the UART is 2400 bps +/- 25%.

To ensure that long term drift and temperature will not affect communication stability, the communication channel must be synchronised on a frequent basis. If the line conditions get low and MLX32001 has to switch down to 1 of its 4 low power modes, synchronisation locking expires to ensure that power supply dependent communication times will never unlock.

There are 64 bytes (512 bits) of user RAM accessible in MLX32001 to store country and network operator dependent settings. These settings are retrieved from a small parameter database that supports data originating from the following 3 sources:

- 1) Type Approval Regulations that more or less specify the network (e.g. what kind of AC termination is required; what levels of open line voltages, ring voltages and online currents can be expected; how are transient timings for online / offline / CLIP and polarity dependent phenomena specified, what common mode unbalance is required)
- 2) Design and market Experience: Known network errors and network non-compliance problems can be implemented in MLX32001 drivers and state machine to let the line interface properly handle interworking problems (e.g. how much spikes can be expected during polarity reversal; how much time does it take the power supply SLIC to switch between online detect and online supply mode; what total current interruptions can be expected; how much time can pass before an acceptable dialtone is detected)
- 3) Local Line Adaptation: Local line adaptation is defined as the ability to measure the telephone line conditions of the actual network termination point

where MLX32001 is powered and accordingly adapt optimally to that telephone network. This means that MLX32001 is capable of measuring all relevant DC and transient phenomena on a telephone line that characterise this line. Consequently settings can be optimised for (extremely) long line operation, low current operation, parallel operation with 1 or more telephones in parallel, line monitoring (detect line transients, line parallel pickup and replace and total line disconnect).

In a PC controlled environment, parameters and drivers are residing in the PC's memory, while the front end (USB) controller such as the USB Cypress C7Y67001 is performing bitwise control and is handling the UART.

MLX32001 is not only a fully line powered device, it also generates power supply for local hosting microcontrollers. It has 2 different sources of power supply generation: AUX5, AUX10 delivering 5 and 10mA nominally if sufficient line current is available. The AUX5 supply can be programmed in steps of 20 μ A. This allows the designer to modify the HOST's supply current while exactly regulating the supply voltage with just an internal A/D convertor input on the HOST.

With those features it is possible to built standalone (modem) applications with hosting controllers like NEC UPD78F9177G, Texas Instruments MSP430-series and Hitachi H8-36XX series. These controllers are then fully line powered but still perform powerful functions like full V.22 modem implementation, S0 contact scanning for utility meters, E-data transfer interface for POS and E-cash modules etc.

Any line interface requiring galvanic separation has a line powered PSTN-side and a HOST controller side where primary controlling power is available. With the MLX32001 there is a consistent and dominant separation between AC and DC handling:

- All non-AC handling is regarded as DC handling and is performed by MLX32001 at the PSTN-powered side, including (im)pulse dialing, overshoot control, polarity detection, hookswitch control, ring detection and line event monitoring. For universal line interface designs, the DC handling part is always identical
- All pure AC-handling is performed at the HOST side, as it differs from application to application and depends on AC line transformer choice, the number of reference termination sections and the number of SMTR feedback filter elements.

For worldwide coverage of Balanced Return Loss 2 impedances are needed. If the design specification is limited to 600E terminating countries only 1 is required. The excellent THD and Noise characteristics are the result of the fully line powered operation. Other DAA's transfer power

supply from the HOST to the PSTN side, giving possible problems for lightning safety, radio interference at higher frequencies and frame ground sensitive coupling problems.

The AC-handler part of the design has not been integrated into MLX32001 for 2 major reasons:

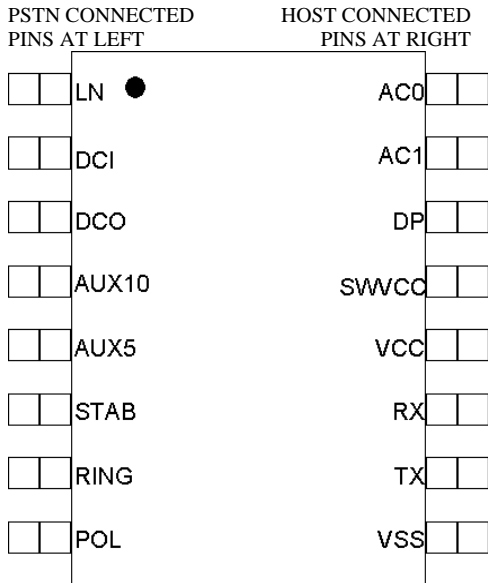
- 1) In designs that include a galvanic separation, the DC-handler is on the line powered side, while the AC-handler resides on the HOST powered side. Since MLX32001 supports each possible line transformer, the DC-handler section is identical for all designs, while the AC-handler part depends very much on line transformer selection.
- 2) For galvanically coupled designs the STMR filters used require capacitor values up to 2.2 μ F. Integrating such high values into silicon will either be expensive or (with some impedance conversion tricks) will result in a Total Harmonic Distortion of the transmitting stage that is higher than the 72dB required by V.90 modems. To allow any design to work with MLX32001 it was decided to build up any appropriate AC-handler by conventional components, thus reaching the best possible THD levels as well as the most cost effective total design setup.

Interworking reliability is the most important aspect of any global line interface. MLX32001 design setup has been done together with a traditional AC-type line transformer for galvanic barrier implementation. This has the following advantages:

- 1) The setup is totally safe for common mode lightning: there are no high voltage capacitors required between the PSTN powered side and the HOST powered side. Since the coupling is inductive, the higher the frequency, the higher the impedance and the lower the coupling currents.
- 2) Proven and reliable electromagnetic coupling technology
- 3) 4kV of separation can be reached supporting global access with 1 transformer
- 4) 2 standard PC-817 opto-couplers are sufficient to pass all MLX32001 digital control signals

Finally, MLX32001 supports full line event monitoring. This means that any line event occurring in online or offline mode will generate an event within MLX32001 where the host decides what to do with it. For modems, this means that other telephones picked up and replaced in parallel can be properly handled without closing down the connection or terminating the download procedures. Also MLX32001 can be linked 'virtually' online. In this mode, MLX32001 based designs never answer incoming calls and never originate calls during line busy states. Also the actual line use versus daytime period is 'monitored' and it is consequently decided what is the best period to make service calls or autodownload configuration data.

6. Pin description



PIN-TYPE DESCRIPTION

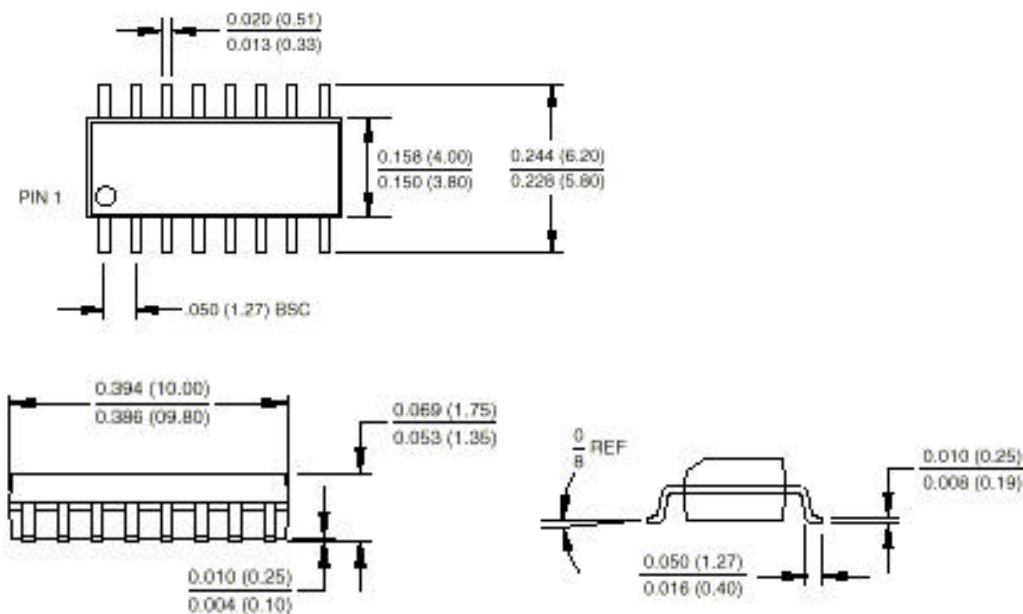
PIN	NAME	PINTYPE
1	LN	ANALOG SIGNAL HV
2	DCI	ANALOG COIL IN
3	DCO	ANALOG COIL OUT
4	AUX10	ANALOG HV
5	AUX5	ANALOG HV
6	STAB	ANALOG COIL REFERENCE
7	RING	ANALOG INPUT
8	POL	ANALOG INPUT
9	VSS	GROUND
10	TX	DIG OUTPUT
11	RX	DIG INPUT
12	VCC	POSITIVE POWER SUPPLY
13	SWVCC	DIG OUTPUT
14	DP	OUTPUT HV
15	AC1	ANALOG SIGNAL HV
16	AC0	ANALOG SIGNAL HV

Note HV = high voltage pin

Remarks :

- Low voltage signals are on the bottom half. High voltage pins at the upper half.
- RING/POL are grouped together and should be routed together on the pcb.
- LN/DCI are grouped together. The highest possible DC current is flowing through these pins.
- Logic control signals are grouped together (RX, TX).
- AC0/AC1 switches AUX5, AUX10 and DP are as close as possible to LN.

7. Package description, dimensions in inches and (millimeters)



8. Electrical specifications

Note: All parameters are specified at 20 degrees Celsius and $V_{CC} = 3.3V$ unless stated otherwise

<i>VCC positive power supply</i>	Reference	Min	Typ	Max	Unit
Operating supply voltage	V_{CC}	1.8	3.3	7.2	V
Reduced operating area supply voltage (SOS)	V_{CC}	1.4		3.2	V
Hysteresis Power-On-Reset circuitry	V_{CCHYST}	0.6			V
Operating supply currents into LN:					
• OFFLINE standby	I_{LN}		7	15	μA
• OFFLINE during activity detect	I_{LN}		70	100	μA
• OFFLINE during activity detect in SOS	I_{LN}		140	200	μA
• ONLINE supply in zener area	I_{LN}	4.0	4.3	4.6	mA
• ONLINE supply not in zener area	I_{LN}	3.1	3.3	3.5	mA
LN input					
Voltage range	V_{LN}	-0.6		42	V
ONLINE current (* Aux10 and Aux5 active and fully on)	I_{ONL}	0.2	3.3	22.1(*)	mA
ONLINE impedance 300-3400Hz DCO off	Z_{ONL}	40			k Ω
Resistor to C_{STAB} for DCO control	RLN_{STAB}	320	400	480	k Ω
Resistor to C_{STAB} in DCO start mode	RLN_{START}	15	21	27	k Ω
Pin capacitance	C_{LN}		100		pF
AC signal distortion in 100..10kHz band between either AC0 and AC1 outputs:	THD			-80	dB
LN input (FA Version)					
Noise generation in 300...3400 Hz band @ BW = 31Hz Relative to a 300E termination	P_{NOISE}			-87	dBm
DCI input					
Voltage range	V_{DCI}	-0.6		$V_{CC}+0.6$	V
Mute current ($V_{DCI}=3V$)	I_{MUTE}		-50		mA
Mute offset ($V_{LN} - V_{DCI}$) @ $I_{MUTE} = 50mA$	V_{MUTE}		1.0	1.5	V
Mute offset ($V_{LN} - V_{DCI}$) @ $I_{MUTE} = 10mA$	V_{MUTE}		0.3	0.4	V
Input impedance to Ground	R_{DCI}	70	87	105	k Ω
Pin capacitance	C_{DCI}		50		pF
DCO output					
Source current ($\beta_{FEDCO} \geq 50, I_{DC} = 100mA$)	I_{OH}	3.5		7.8	mA
Sink current	I_{OL}		3.0		mA
Q_{DCO} DC current gain Output impedance from DCO	$Q_{DCO} H_{FE}$ R_{DCO}	50		100	Ω
Voltage range		-0.6		3.6	V
Pin capacitance when DCO disabled	C_{DCO}		50		pF
Output impedance	Z_{DCO}			100	Ω
AUX10 output					
Auxiliary voltage range	V_{AUX10}	-0.6		42	V
DC Leakage current	$I_{AUX10LEAK}$			1	μA
Supply current	I_{AUX10}	9.5	10	10.5	mA
Input impedance to Ground when disabled	R_{AUX10}	10			M Ω
Input impedance to LN when enabled	Z_{AUX10}	1			M Ω
Pin capacitance	C_{AUX10}		20		pF

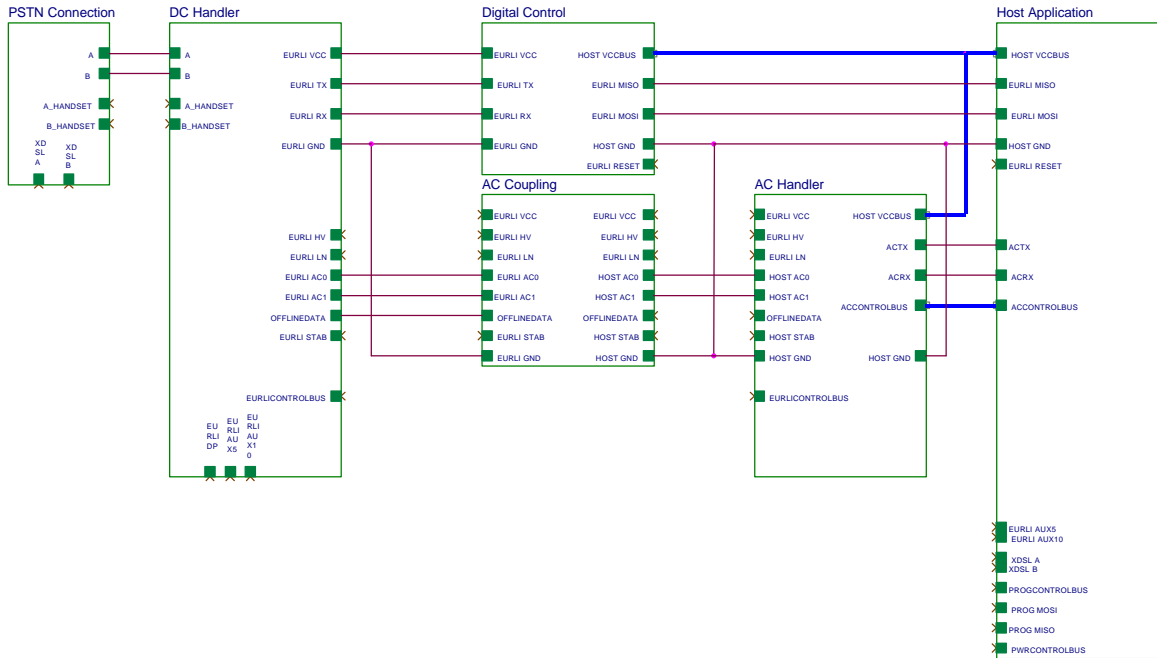
AUX5 output					
Auxiliary voltage range	V_{AUX5}	-0.6		42	V
Battery backup current ($V_{LN} \geq 4V$)	$I_{AUX5BACKUP}$	-4		-25	μA
Supply current	I_{AUX5}	4.5	5	5.5	mA
Input impedance to Ground when disabled	R_{AUX5}		8		M Ω
Input impedance to LN when enabled	Z_{AUX5}		400		k Ω
Pin capacitance	C_{AUX5}		20		pF
SPYMODE operation:					
1 LSB DC current step	$I_{AUX5STEP}$	18	20	22	μA
Spymode Full Range current			I_{AUX5}		mA
STAB input					
Voltage range	V_{STAB}	-0.6		$V_{CC}+0.6$	V
Discharge peak current	$I_{STABDIS}$			5	mA
DC Leakage @ 1 LSB V_{LN} programming error	$I_{STABLEAK}$			300	nA
Pin capacitance	C_{STAB}		3		pF
RING input					
Voltage range	V_{RING}	-0.6		$V_{CC}+0.6$	V
AC Input impedance relative to C_{STAB}	Z_{INRING}	0.75	1	1.25	M Ω
DC Leakage current	$I_{RINGLEAK}$			100	nA
Pin capacitance	C_{RING}		3		pF
POL input					
Voltage range	V_{POL}	-0.6		$V_{CC}+0.6$	V
AC Input impedance relative to C_{STAB}	Z_{INPOL}	0.75	1	1.25	M Ω
DC Leakage current	$I_{POLLEAK}$			100	nA
Pin capacitance	C_{POL}		3		pF
TX output					
Output voltage LOW ($I_{OL}=0.5mA$)	V_{OLTX}			0.3	V
DC Leakage current	I_{TXLEAK}			100	nA
Output sink current at $V_{CC} > 2.1V$	I_{TXSINK}	1.7		3.5	mA
Max. data transfer cap. in OFFLINE ($I_{TXSINK}= 500\mu A$)	$N_{TXMAXBYTES}$			30	Bytes/s
Pin capacitance	C_{TX}		3		PF
RX input (FA) version					
Quiescent current from RX ($V_{RX} = 0V$)	RPU_{RX}			-5	μA
Input voltage low	V_{ILRX}	0.1			V
Input voltage high	V_{IHRX}			0.3	V
Hysteresis ¹	V_{RXHYST}		0		V
Maximum data transfer capacity in OFFLINE	$N_{RXMAXBYTES}$			60	Bytes/s
Pin capacitance	C_{RX}		3		PF
UARTFLEX locking area for 0x55 SYNC_WDR	$T_{LOCKSPAN}$	1800	2400	3000	Bits/s
RX input (EE) version					
Pull-up resistor to V_{CC}	RPU_{RX}		66		k Ω
Input voltage low	V_{ILRX}			0.33V _{CC}	V
Input voltage high	V_{IHRX}	0.66V _{CC}			V
Hysteresis	V_{RXHYST}		0.6		V

¹ The RX pin in FA version is a current sourced driving pin that eliminates the typical miller capacity problem of an optocoupler. There is no voltage change on the pin during transfer.

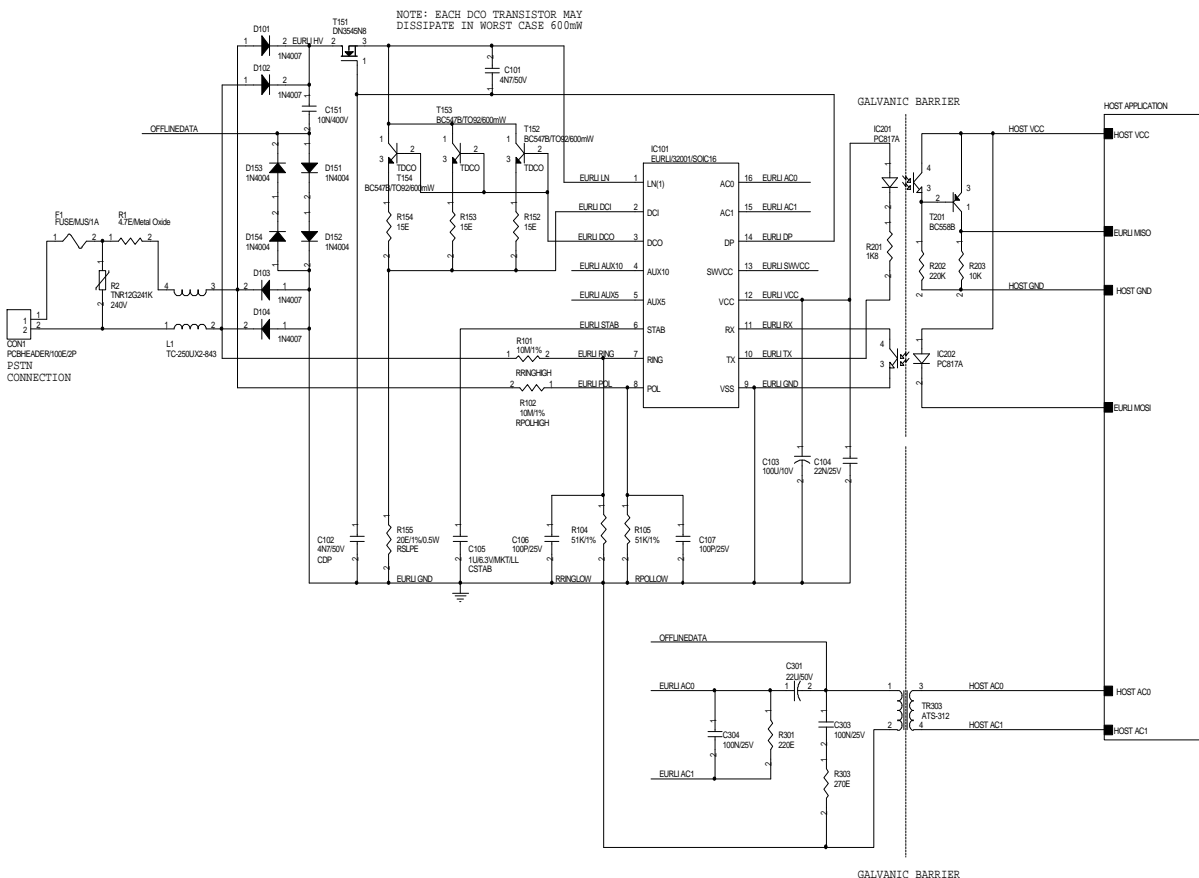
Maximum data transfer capacity in OFFLINE	$N_{RXMAXBYTES}$			30	Bytes/s
Pin capacitance	C_{RX}		3		pF
UARTFLEX locking area for 0x55 SYNC_WDR	$T_{LOCKSPAN}$	1800	2400	3000	Bits/s
SWVCC output					
SWVCC Voltage range	V_{AUX5}	-0.6		$V_{CC}+0.6$	V
Leakage current (low level)	$I_{SWVCCLEAK}$			-1	μA
Drive current (high level)	I_{SWVCC}	0.25	0.5	1.0	mA
Pin capacitance	C_{SWVCC}		6		pF
DP output					
DP Voltage range	V_{DP}	-0.6		42	V
DP Maximum current sink	I_{OLDP}	200			μA
DP Leakage current	I_{LKD}			100	nA
Capacitance to Ground	C_{DPMIN}	3.3			nF
Resistance to LN in ONLINE ($V_{LN} \geq 4V$)	R_{DPLN}		10		k Ω
AC0 & AC1 output					
Voltage range	V_{AC}	-0.6		42	V
Resistance to LN (closed, $V_{LN} \geq 4V$)	R_{ONAC}	16	25	36	Ω
Resistance to GND (1 opened, $V_{LN} \geq 4V$)	R_{OFFAC}	600			k Ω
Resistance to GND (both closed, $V_{LN} \geq 4V$)	R_{OFFAC}	350			k Ω
Internal clock frequency low speed mode	F_{OSLOW}	196	200	204	kHz
Internal clock frequency highspeed mode	F_{OSHIGH}	3.136	3.2	3.264	MHz
Operating temperature	$T_{OPERNORM}$	0	20	70	$^{\circ}C$

9. Typical application diagrams

9.1 V.90 modem

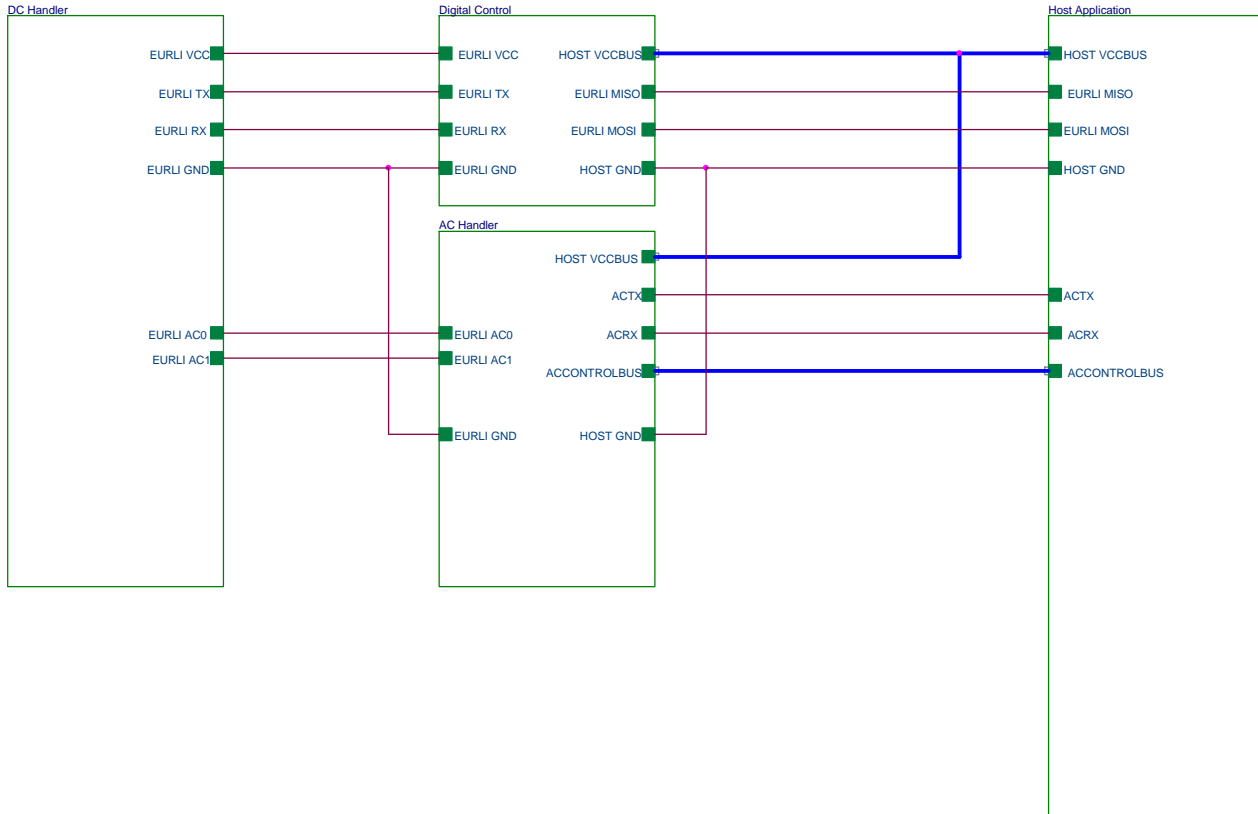


Block diagram

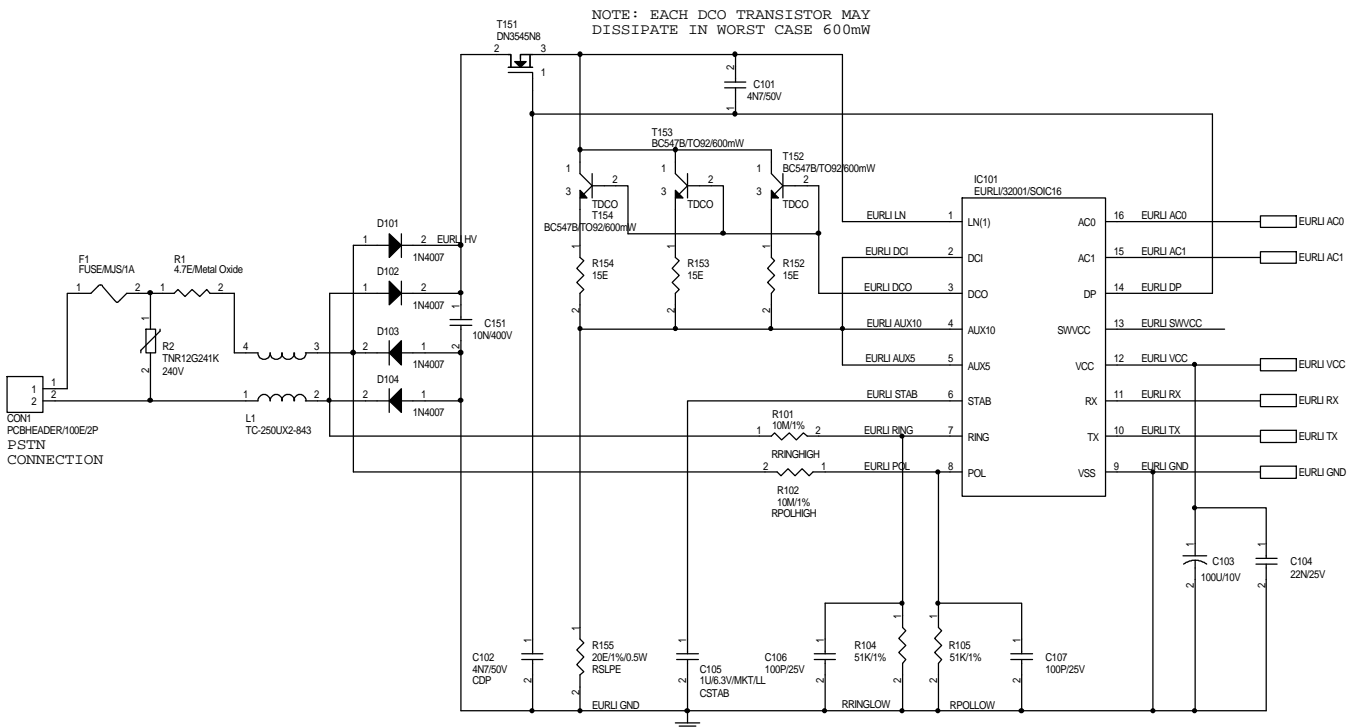


Line interface, DC-handler and line transformer

9.2 PC-Voice

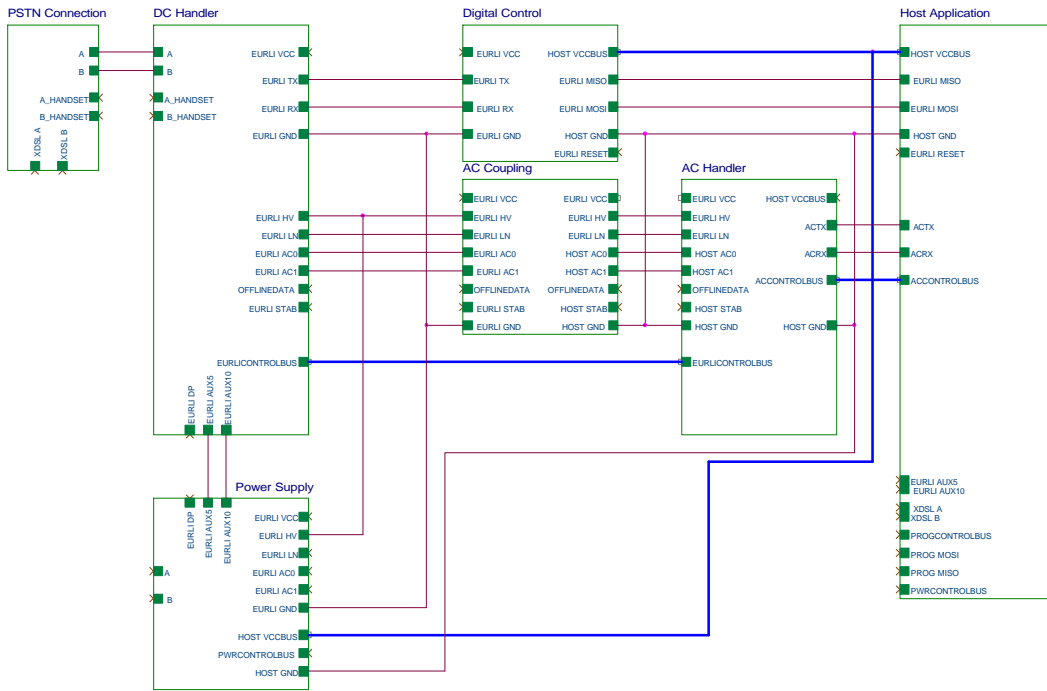


PC-Voice block diagram

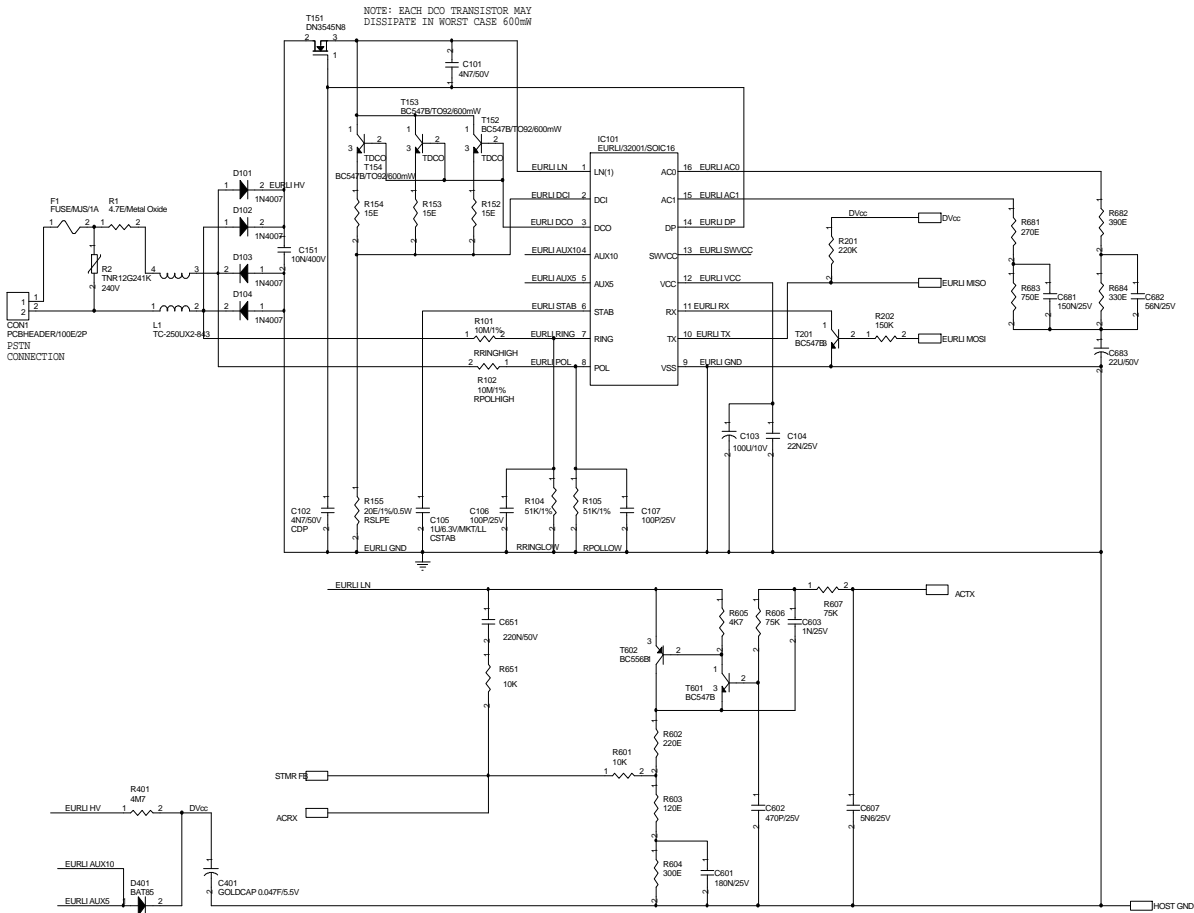


PC-Voice line interface and DC-handler

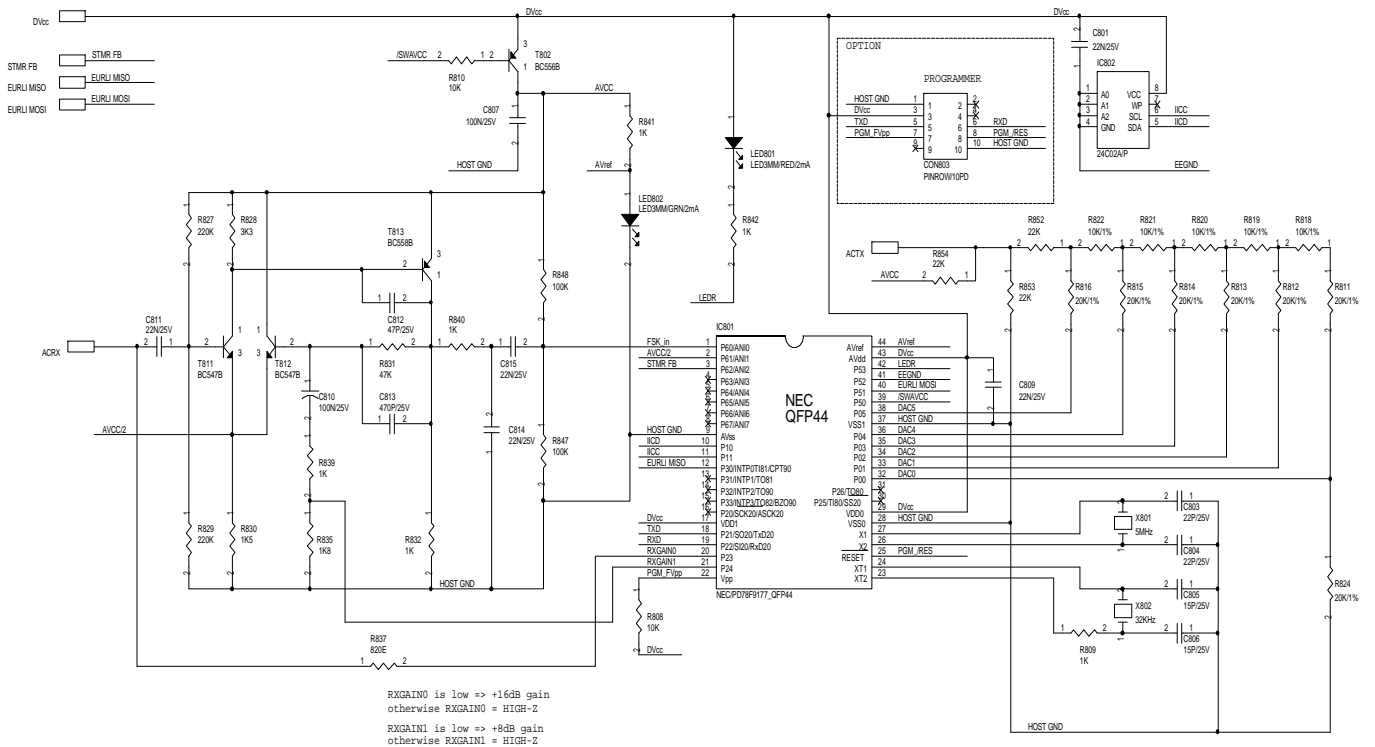
9.3 Line powered modem / meter reading / POS application



Block diagram



AC- and DC-handler



Host application and RX-amplifier

10. Information

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