Cellular Engine TC35

The extra compact module for voice and data transmission

Application Note:	**AUDIO Interface**
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Technical Support:	**wm.support@mch.siemens.de**
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General note

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This product is not intended for use in life support appliances, devices or systems where a malfunction of the product can reasonably be expected to result in personal injury. Siemens AG customers using or selling this product for use in such applications do so at their own risk and agree to fully indemnify Siemens for any damages resulting from illegal use or resale.

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Subject to change without notice at any time.

1 Introduction

The purpose of this document is to provide technical recommendations for designing the audio interface intended for a TC35 based cellular application.

Specifications subject to change without notice. This product is an original Siemens product protected by US, European and other patents.

1.1 References

TC35_HW_Interface_description

1.2 Terms and Abbreviations

DSB35	Development Support Box 35
EMC	Electro Magnetic Compatibility
EMI	Electromagnetic Interference
EPP	Ear Peace Positive
EPN	Ear Peace Negative
ESD	Electrostatic discharge
GSM	Global System for Mobile Communication
RF	Radio Frequency
MICP	Microphone Positive
MICN	Microphone Negative
PCB	Printed Circuit Board
SIM	Subscriber Identifier Module
VANA	Voltage Analog
VREF	Voltage Reference

2 General

The purpose of this document is to provide recommendations for integrating audio accessories into your TC35 application. To give an example, the technical specifications proceed from the certified Siemens reference GSM application that consists of the following components:

- TC35 module
- DSB35 Support box
- Siemens M20 Terminal Handset.

The DSB35 Support Box can be purchased for testing and evaluating GSM applications that incorporate the TC35 module. Click here for more details and ordering information: http://www.siemens.com/wm

2.1 Approval Considerations

For Europe (R&TTE) it is not mandatory to provide an extra approval for the audio equipment that integrates with the TC35 GSM engine. However, should your application be enhanced beyond the certified Siemens reference configuration, it is recommended that you apply for an additional approval.

In other countries, you are required to obtain an extra approval when your audio equipment differs from the audio schematics detailed below.

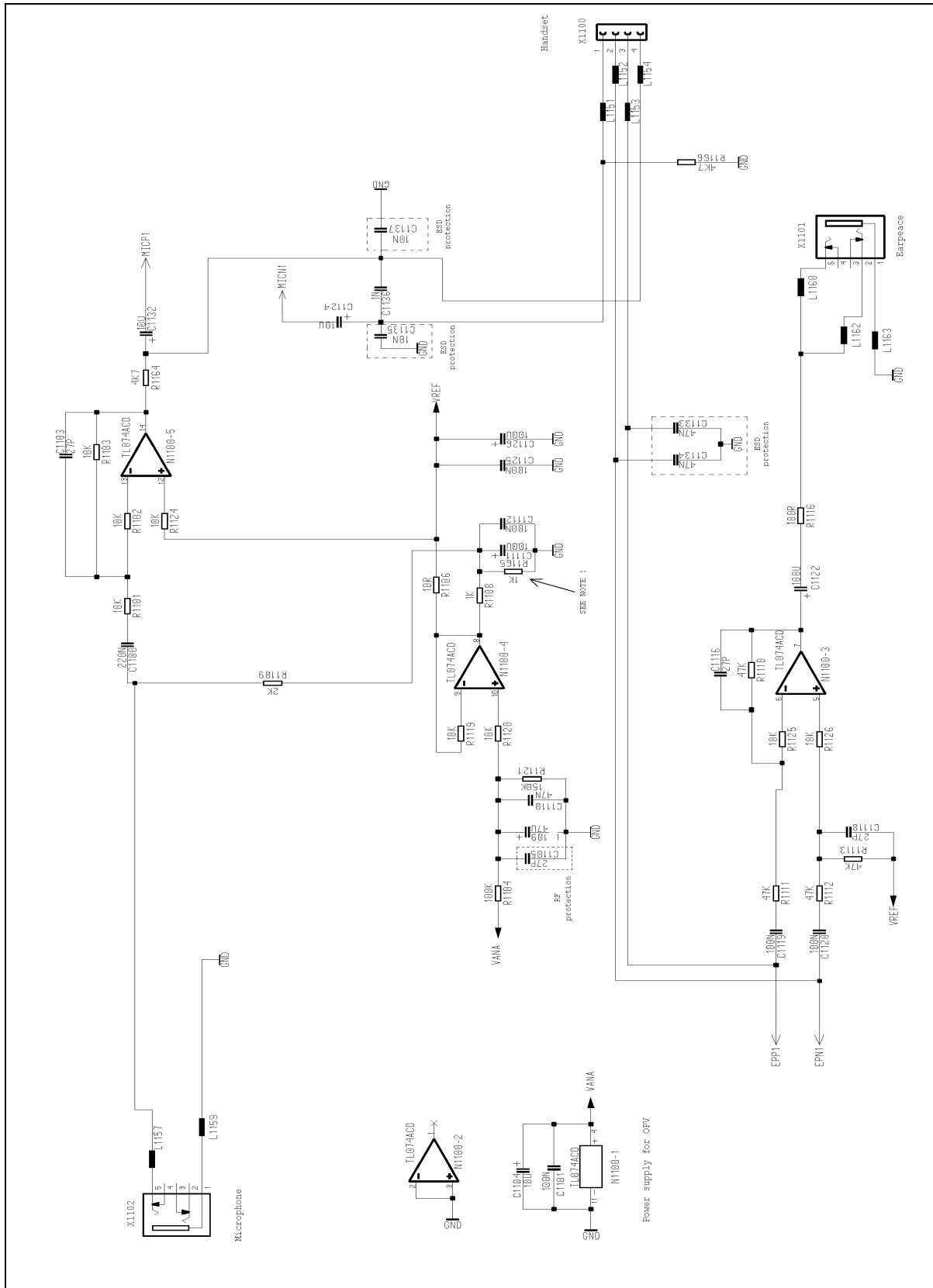## 3   Audio Interface Schematic

Figure 1: Audio Interface Schematic on the DSB35 Support Box

*) Note (to Figure 1)

The two R1108 (1K) and R1165 (1K) resistors are used as voltage dividers for the microphones. In the schematic both resistors are designed as 1k. This results in 6V for the handset microphone (powered over R1106) and 3V behind R1108 (1K) to supply the external microphone (X1102). By using different resistor values for R1165 you can vary the power supply for your external microphone.

3.1   Description of the receive path

The differential output signal EPP1/EPN1 of the TC35 connects directly to X1100 pin 3 and 2 via the EMI chokes L1153 and L1152.

Two capacitors (C1133 and C1134) protect EPP1/EPN1 against ESD.

In parallel to EPP1/EPN1 the differential amplifier N1100-3 picks up the signal from the TC35 module to the earpiece jack X1101, converting it into an asymmetric output signal to ground. This amplifier with unity gain can drive a stereo headphone plugged into X1101.

The handset itself does not need the amplifier N1100-3.

3.2   Description of the transmit path

The amplifier N1100-5 provides a dc output voltage of 6V for feeding the handset's microphone. This feeding current flows via R1164 (4k7), L1154, X1100 and pin 4 through the microphone. It returns via X1100, pin 1, L1151and R1166 (4k7) to ground.

The differential microphone signal is picked up by the TC35's MICP1 and MICN1 pins through the decoupling capacitors C1132 and C1124.

ESD protection is provided by C1135 to C1137.

An external electret microphone can be connected to jack X1102, which provides a 3V feeding source with a resistance of 2k. This signal is superimposed to the feeding voltage of the handset's microphone by the unity gain amplifier N1100-5.

In applications with the M20T handset and without any external microphone, N1100-5 can be replaced with any 6V dc source.

3.2.1 Earpiece stereo jack (X1101)

The earpiece signal is generated by the audio interface (earpiece signal output, pin 2 and pin 5). The audio interface can be designed as a 3.5 mm stereo connector like the X1101 jack located on the DSB35 Support Box board.
On the DSB35 Support Box board, the X1101 earpiece jack and the X1100 Western jack for the handset are connected in parallel.

The stereo jack connections are shown in Figure 2 below.

1 Ground
2 Earpiece Signal Output
3 n. c.
4 n. c.
5 Earpiece Signal Output (=Pin 2)

Figure 2: Pin assignment - X1101 jack for earpiece signal

3.2.2 Microphone Signal (X1102)

For the microphone signal, the DSB35 Support Box board uses a 3.5 stereo jack (external mic. input, pin 5). In Figure 1 it is designated X1102.
On the DSB35 Support Box board, the X1102 microphone jack and the X1100 Western jack for the handset are connected in parallel.
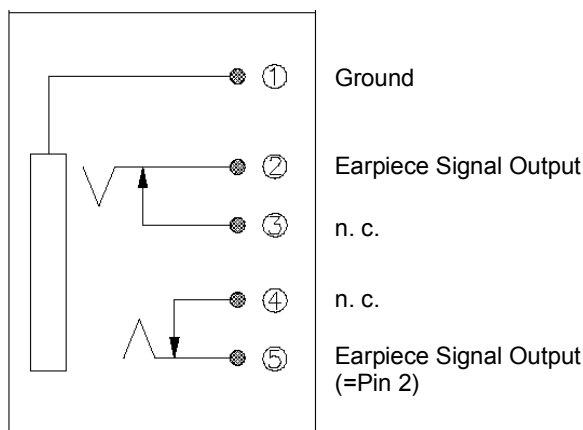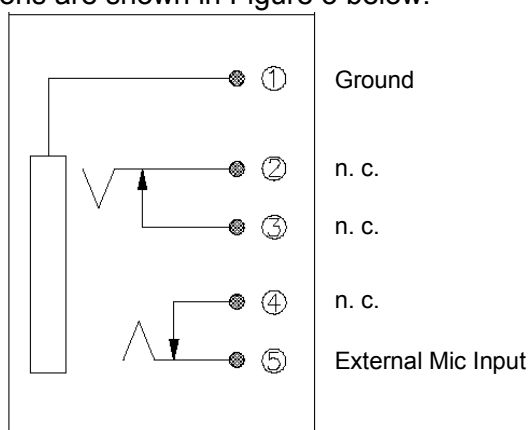The stereo jack connections are shown in Figure 3 below.

1 Ground
2 n. c.
3 n. c.
4 n. c.
5 External Mic Input

Figure 3: Pin assignment – X1102 jack for microphone signal

3.3 Handset connector (X1100)

To include a handset into your TC35 application, e.g. for audio measurements, you can also follow the specification of the DSB35 Support Box:
The box uses a 4-pin Western jack for this purpose. For the power supply of the microphone there is a voltage of 6V (over 2 x 4.7kΩ) available between Pin 4 and pin 1. The pin assignment (pin numbering from left to right) of the Western jack is shown in Table 1 below:

Signal name	Pin	I/O	Description
HS_MIC-	1	I	Microphone minus
HS_LS-	2	O	Loudspeaker minus
HS_LS+	3	O	Loudspeaker signal
HS_MIC+	4	I	Microphone signal

Table 1: Pin assignment of the Western jack used for the Handset

4 Power supply for audio interface

The following schematic illustrates an example of how to design a power supply for the analog power of the audio interface (VANA).

The MAX1683 (Maxim semiconductor) is a voltage doubler. It allows to use the 5V digital power from your host interface to generate the required 10V analog power for the audio part.
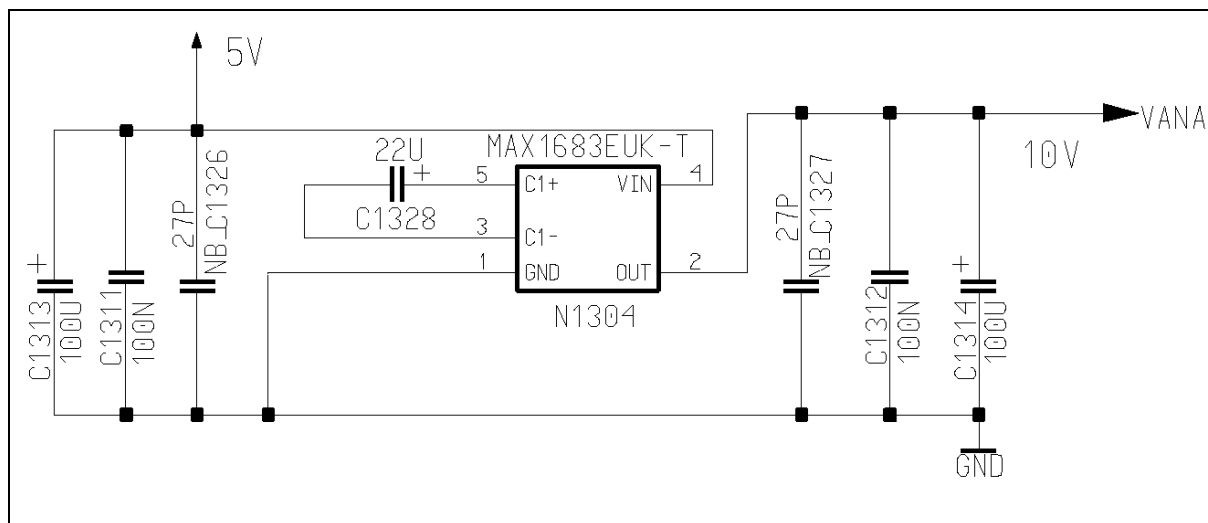

Figure 4: Analog power supply

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5   Component lists

5.1   Bill of material (audio interface)

Pos	Label	Component	-Tol	+Tol	Form	U / P	Others
1	C1100	220N	10%	10%	0603	10	
2	C1101	100N	80%	20%	0402	16	
3	C1103	27P	5%	5%	0402	25	
4	C1104	10U	20%	20%	Tantal A	10	
5	*C1105*	*27P*	*2%*	*2%*	0402	*25*	*RF protection*
7	C1109	47U	20%	20%	Tantal D	16	
8	C1110	47N	10%	10%	0805	25	
9	C1111	100U	20%	20%	Tantal D	16	
10	C1112	100N	80%	20%	0402	16	
11	C1116	27P	5%	5%	0402	25	
12	C1118	27P	5%	5%	0402	25	
13	C1119	100N	80%	20%	0402	16	
14	C1120	100N	80%	20%	0402	16	
15	C1122	100U	20%	20%	Elko E	25	
16	C1124	10U	20%	20%	Tantal A	10	
17	C1125	100N	20%	20%	0402	16	
18	C1126	100U	20%	20%	Tantal E	16	
21	C1132	10U	20%	20%	Tantal A	10	
22	C1133	47N	10%	10%	0805	25	
23	C1134	47N	10%	10%	0805	25	
24	C1135	10N	10%	10%	0603	50	
25	C1136	1N	5%	5%	0603	25	
26	C1137	10N	10%	10%	0603	50	
27	L1151	600R/100MHZ	0%	0%	0805		Murata
28	L1152	600R/100MHZ	0%	0%	0805		Murata
29	L1153	600R/100MHZ	0%	0%	0805		Murata
30	L1154	600R/100MHZ	0%	0%	0805		Murata
31	L1157	600R/100MHZ	0%	0%	0805		Murata
32	L1159	600R/100MHZ	0%	0%	0805		Murata
33	L1160	600R/100MHZ	0%	0%	0805		Murata
34	L1162	600R/100MHZ	0%	0%	0805		Murata

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Pos	Label	Component	-Tol	+Tol	Form	U / P	Others
35	L1163	600R/100MHZ	0%	0%	0805		Murata
36	N1100-1	TL074ACD	-	-	SO14		Texas Instrument
37	N1100-2	TL074ACD	-	-	SO14		Texas Instrument
38	N1100-3	TL074ACD	-	-	SO14		Texas Instrument
39	N1100-4	TL074ACD	-	-	SO14		Texas Instrument
40	N1100-5	TL074ACD	-	-	SO14		Texas Instrument
41	R1101	10K	1%	1%	0402		
42	R1102	10K	5%	5%	0402		
43	R1103	10K	5%	5%	0402		
44	R1104	100K	1%	1%	0402		
45	R1106	10R	2%	2%	0805		
47	R1108	1K	5%	5%	0402		
48	R1109	2K	2%	2%	0603		
49	R1110	47K	5%	5%	0402		
50	R1111	47K	5%	5%	0402		
51	R1112	47K	5%	5%	0402		
52	R1113	47K	5%	5%	0402		
54	R1116	100R	2%	2%	0805		
57	R1119	10K	5%	5%	0402		
58	R1120	10K	5%	5%	0402		
59	R1121	150K	1%	1%	0402		
60	R1123	10K	5%	5%	0402		
61	R1124	10K	5%	5%	0402		
62	R1125	10K	5%	5%	0402		
63	R1126	10K	5%	5%	0402		
64	R1164	4K7	1%	1%	0603		
65	*R1165*	*1K*	*1%*	*1%*	0402		*See note in Chapter 3*
66	R1166	4K7	5%	5%	0402		
67	X1100	4-POL	-	-	4P4C Western		
68	X1101	5-POL	-	-	5pol stereo jack		
69	X1102	5-POL	-	-	5pol stereo jack		

Table 2 : Bill of Material (audio Interface)

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5.2   Bill of material (audio power interface)

Pos	Label	Component	-Tol	+Tol	Form	U / P	Others
1	N1304	MAX1683-EUK-T	-	-	SOT23-5		Maxim
2	C1311	100N	80%	20%	0805	25	
3	C1312	100N	80%	20%	0805	25	
4	C1313	100U	80%	20%	Tantal E	16	
5	C1314	100U	20%	20%	Tantal E	16	
6	*C1326*	*27P*	*2%*	*2%*	0402	*25*	*RF protection*
7	*C1327*	*27P*	*2%*	*2%*	0402	*25*	*RF protection*
8	C1328	22U	20%	20%	Tantal D	25	

6 Avoiding RF and electromagnetic interferences

6.1 RF Protection

In order to prevent your TC35 application from causing RF interference across the audio path, you may be required to add capacitors on the PCB.
For the layout of your application it is essential, that these capacitors are located close to the pins to be protected.

Example
Capacitors placed on the board of the DSB35 Support Box:
- Audio Schematics – C1105
- Audio Power Schematics – C1326, C1327

6.2 EMC

To ensure that your TC35 application meets EMC requirements, it is recommended to add inductors for protecting external connectors.
For the layout of your application it is essential, that these inductors are located close to the connectors they are required for.
The inductors can be replaced with zero Ohm resistors.

Example
Inductors placed on the board of the DSB35 Support Box:
- L1151,L1152, L1153, L1154, L1157, L1159, L1159, L1160, L1162, L1163

7 Type Approved Handset for TC35

The M20 Terminal handset is used as the reference handset in conjunction with the DSB35 Support Box and the TC35 module and, therefore, forms part of the certified Siemens reference configuration for TC35.

This passive handset requires a power supply for the microphone as shown in Figure 1. An adapter amplifier (Figure 1) and the power supply (Figure 4) required for the handset are available on the DSB35 Support Box.

Other handset types you may want to integrate into your TC35 application are not covered by the approval issued for the Siemens reference configuration. You may therefore be required to achieve an extra approval for specific handsets or audio equipment (see also Chapter 2).

Odering information
M20 Terminal Handset (Siemens product no. S30880-S8001-A300-1)