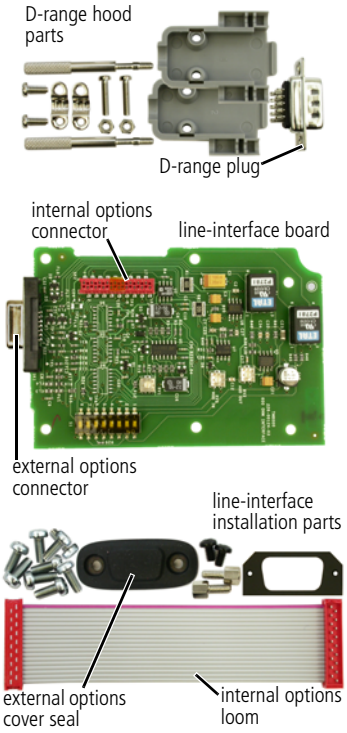
2 TMAA01-01 Line-Interface Board



The TMAA01-01 line-interface board provides both audio and digital interfaces for a variety of systems. The interfaces available are:

- an isolated 600Ω audio interface which is capable of both simplex operation on a two-wire system, or duplex operation on a four-wire system
- a keying interface which allows for two-wire keying or single line bi-directional keying
- a variable delay timer
- a logic sense control.

The line-interface board fits inside the radio in the options cavity and is connected to the main PCB by the internal options loom. The high-density 15-way D-range connector mounted on the line-interface board fits through the external options connector hole provided in the radio chassis.

Important The radio does not meet the IP54 protection standard once a line-interface board has been installed unless the external options cover seal is installed.

2.1 Operation

One of the control head function keys may be programmed to toggle the line-interface board on and off. When the function key LED is glowing, the line-interface board is on and when the LED is off, the line-interface board is off.

Refer to "Programming Information" on page 23 for information on the radio programming procedure.

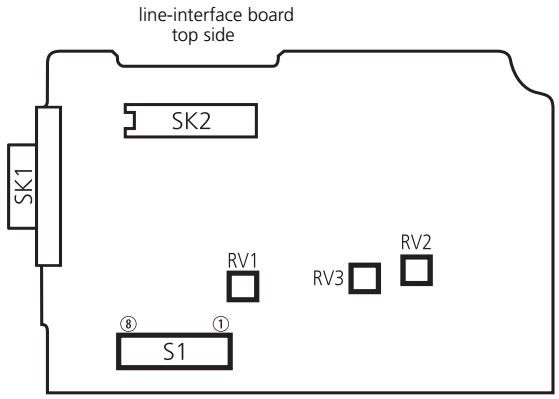
2.2 Configuring the Line-Interface Board

Important This equipment contains devices which are susceptible to damage from static charges. Refer to "ESD Precautions" on page 13 for more information.

2.2.1 Adjustment Points on the Line-Interface Board

The following table describes the line-interface adjustment points. Adjustments are made by setting the DIP switches on S1 to either "on" or "off" and by three variable resistors (RV1, RV2 and RV3).

Table 2.1 Line-interface board adjustment points

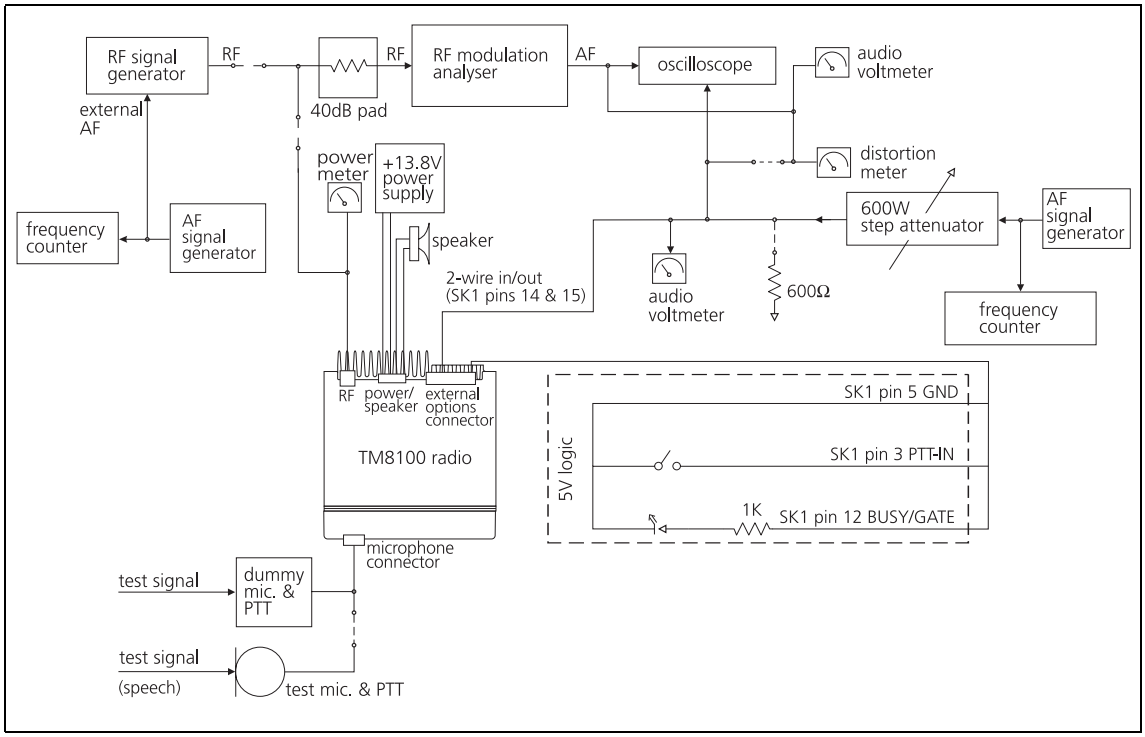


Function	Selection 1	Selection 2
two-wire audio interface	DIP1 on	DIP2 off
four-wire audio interface	DIP1 off	DIP2 on
busy/gate = busy	DIP3 on	DIP4 off
busy/gate = rx-gate	DIP3 off	DIP4 on
busy/gate logic inverted	DIP5 off	DIP6 on
busy/gate logic normal	DIP5 on	DIP6 off
bi-directional keying line	DIP7 on	
two-wire keying	DIP 7 off	
enable keying delay	DIP8 off	
keying delay	adjust RV1	
audio line out level	adjust RV2	
audio line in level	adjust RV3	

2.2.2 Test Equipment Setup

The following diagram shows the setup of the test equipment used when adjusting RV1, RV2 and RV3.

Figure 2.1 Line-interface test equipment setup



2.2.3 Configuration Procedure

The line-interface board configuration must be completed before the board is installed in the radio, as the top side of the line-interface board is not accessible once the board is screwed to the radio lid. To configure the line-interface board, carry out the following steps.

1. Program the radio in which the line-interface board is being installed with default line-interface test settings. The default test settings are explained in the following tables.

Note A general description of IOP_GPIO lines used with the line-interface board is given in Table 2.6 on page 23.

Table 2.2 Line-interface default test settings in the Programmable I/O form, Digital tab

Pin	Direction	Label	Action	Active	Debounce	Signal State	Mirrored
IOP_GPIO1	Input	None	External PTT 1	Low	60	None	None
IOP_GPIO2	Output	0	No Action	Low	None	None	None
IOP_GPIO3	Output	BUSY	Busy Status	High	None	None	None
IOP_GPIO4	Output	FKEY	F1 Key Status[a]	Low	None	Latching	None

a. One of the four control head function keys may be selected to control the line-interface AUX line, which turns the line-interface board on and off. For the associated LED to reflect the status of the line-interface board, the Function Key Action field on the Key Settings form must be set to Action Digital Output Line.

Table 2.3 Line-interface settings in the Programmable I/O form, Audio tab

Rx/PTT Type	Tap In	Tap In Type	Tap In Unmute	Tap Out	Tap Out Type	Tap Out Unmute
Rx	None	A-Bypass In	On PTT	R7	D - Split	Busy Detect
EPTT1	T5	A-Bypass In	On PTT	None	C-Bypass 0	On PTT

Table 2.4 Line-interface settings in the PTT form, External PTT (1) tab

Field		Setting
Advanced PTT	PTT Transmission Type	Voice
	Audio Source	Audio Tap In

2. Set the DIP switches on the line-interface board (S1) to the following default test settings:
   - DIP1 on (two-wire audio interface)
   - DIP2 off
   - DIP3 off
   - DIP4 on (busy/gate = rx-gate)
   - DIP5 on (busy/gate logic normal)
   - DIP6 off
   - DIP7 off (two-wire keying)
   - DIP8 off (time delay enabled).

3. Disassemble the radio in order to gain access to the options cavity. For detailed disassembly instructions, refer to the disassembly procedure in the TM8100 Service Manual.

   Connect the internal options loom between SK2 on the line-interface board and SK102 on the radio's main PCB.

4. Set up the test equipment shown in Figure 2.1, and follow the adjustment procedure for RV1, RV2 and RV3 described in the following section.

2.2.4 Adjusting RV1, RV2 and RV3

Setting the Keying Time Delay (RV1)

The keying time delay circuit is used to prevent the burst of noise occurring before a mobile is able to mute the audio when the carrier signal disappears. The keying time delay is used in conjuction with the keying signal (SK1 pin 1).

Set DIP8 off, and adjust RV1 for the required time delay. Rotate RV1 clockwise to increase the delay, and counterclockwise to reduce the delay.

Setting the Line Output Level (RV2)

Monitor the line output (SK1 pins 14 and 15) and apply an on-channel signal from the RF signal generator at an output level of -47 dBm, modulated to 60% of system deviation, at 1 kHz AF.

Adjust the RV2 for a line output level of -10 dBm.

Setting the Line Input Level (RV3)

Apply a line input signal of -10 dBm and key the transmitter.

- For a two-wire configuration, apply the line input signal to pins 14 and 15 on SK1.
- For a four-wire configuration, apply the line input signal to pins 4 and 10 on SK1.

Adjust RV3 until 60% of system deviation at 1 kHz is achieved.

2.3 Installing the Line-Interface Board

Note The line-interface board link options must be set before the board is installed in the radio, as the top side of the line-interface board is not accessible once the board is screwed to the radio lid.

2.3.1 Parts Required

The following table describes the parts required to install a line-interface board in a radio. The parts marked with an asterisk (★) are not shown in Figure 2.2 and are used to connect to the radio's external options connector.

Table 2.5 Line-interface installation parts required

Quantity	Internal Part Number	Description	Figure 2.2 Reference
1	362-01110-XX[a]	foam seal	③
1	362-01108-XX[a]	cover seal	⑪
2	347-00011-00	4-40x3/16 screws	⑫
2	354-01043-00	screw-lock fasteners	⑦
6	349-02062-00	M3x8 screws	⑨
★1	240-00010-80	D-range plug	—
★1	240-06010-29	D-range hood	—

a. Contact Technical Support for the exact IPN.

2.3.2 Installation Procedure

1. Disassemble the radio in order to gain access to the options cavity.

   For detailed disassembly instructions, refer to the disassembly procedure in the TM8100 Service Manual.

The circled numbers in the following instructions refer to items in the diagram on the previous page.

2. Remove the top cover and lid ① from the radio to access the options cavity.

3. Remove the external options connector bung ②, if it is fitted.

4. On the inside of the radio lid place the foam seal ③ over the external options connector cavity ④.

5. With the top side of the line-interface board ⑤ facing the radio lid, guide the external options connector ⑥ (the D-range connector on the line-interface board) into the external options connector cavity.

6. Screw the external options connector to the radio lid using the two screw-lock fasteners ⑦.

   Tighten the fasteners to a torque of 0.9N·m (8lbf·in).

Important The external options connector screw-lock fasteners must be tightened correctly before screwing the line-interface board onto the mounting posts ⑧.

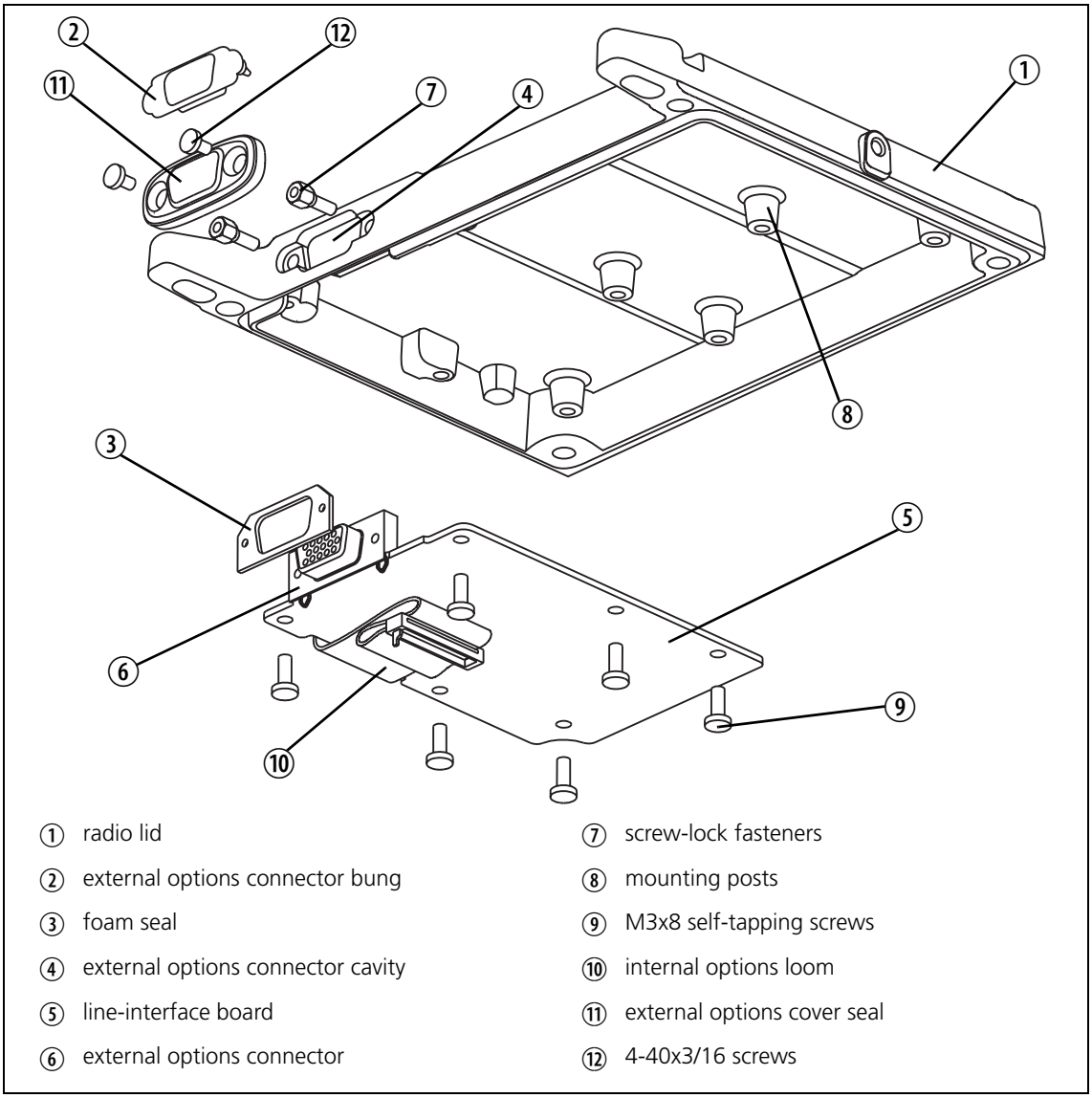
7. Screw the line-interface board to the mounting posts on the radio lid using six M3x8 self-tapping screws ⑨.

   Tighten the M3x8 screws to a torque of 1.9N·m (17lbf·in)

8. Plug the unattached end of internal options connector loom ⑩ into the internal options connector on the radio main PCB.

9. Refit the radio lid and top cover to the radio and screw the external options cover seal ⑪ over the external options connector, using the two 4-40x3/16 screws ⑫.

Figure 2.2 Installing the line-interface board



① radio lid
② external options connector bung
③ foam seal
④ external options connector cavity
⑤ line-interface board
⑥ external options connector
⑦ screw-lock fasteners
⑧ mounting posts
⑨ M3x8 self-tapping screws
⑩ internal options loom
⑪ external options cover seal
⑫ 4-40x3/16 screws

2.4 Programming Information

The lines from the radio's internal options connector that are used by the line-interface board are IOP_GPIO1 to IOP_GPIO4. The behaviour of these lines is configured in the Programmable I/O and PTT forms of the TM8000 Programming Application. Refer to the online help of the programming application for more information.

The Table 2.6 explains the required input and output line-interface connections.

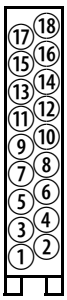
Table 2.6 Line-interface input and output connections

Radio Signal	Function	Comments
GPIO1	PTT FROM OPT	This signal causes the radio to transmit. This normally requires External PTT1 to be set up in the Digital tab of the Programmable I/O form and the External PTT (1) tab of the PTT form.
GPIO2	Busy/Gate	This active high signal allows connection to the Busy/Gate output signal. If this is not used, the Action field is set to No Action and the Active field is set to Low.
GPIO3	Busy/Gate (Keying Line)	This active high signal allows connection to the Busy/ Gate output signal. This signal also allows the single line keying functionality.
GPIO4	AUX	This allows the line-interface board to be disabled. One of the four control head function keys is selected to control this AUX line. For the associated LED to reflect the status of the line-interface board, the Function Key Action field on the Key Settings form must be set to Action Digital Output Line.

2.5 Interface Specification

The following tables summarize the signals used for the line-interface board on the internal options connector (SK2 on the line-interface board) and the external options connector (SK1 on the line-interface board).

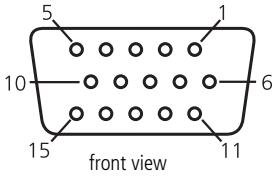
Table 2.7 Internal options connector (SK2) - pins and signals



top view

Pin	Radio Signal	Line-Interface Signal	Description
1	13V8_SW	13V8 FROM RADIO	switched 13V8 supply from the radio
2	AUD_TAP_OUT	AUDIO TAP OUT	Programmable tap point out of the receive or transmit audio chain.
3	AGND	AGND	analogue ground
4	AUX_MIC_AUD	—	not connected
5	RX_BEEP_IN	—	not connected
6	AUD_TAP_IN	AUD_TAP_IN	Programmable tap point into the receive or transmit audio chain.
7	RX_AUD	—	not connected
8	RSSI	—	not connected
9	IOP_GPIO1	PTT FROM OPT	IOP_GPIO1 from the radio 3V3 logic level, 5V tolerant
10	IOP_GPIO2	SECONDARY BUSY	IOP_GPIO2 from the radio 3V3 logic level, 5V tolerant
11	IOP_GPIO3	BUSY	IOP_GPIO3 from the radio 3V3 logic level, 5V tolerant
12	IOP_GPIO4	AUX	IOP_GPIO4 from the radio 3V3 logic level, 5V tolerant
13	IOP_GPIO5	GPIO5	IOP_GPIO5 from the radio 3V3 logic level, 5V tolerant
14	IOP_GPIO6	—	not connected
15	IOP_GPIO7	—	not connected
16	DGND	AGND	analogue ground
17	IOP_RXD	RXD	asynchronous serial port - receive data
18	IOP_TXD	TXD	asynchronous serial port - transmit data

Table 2.8 External options connector (SK1) - pins and signals

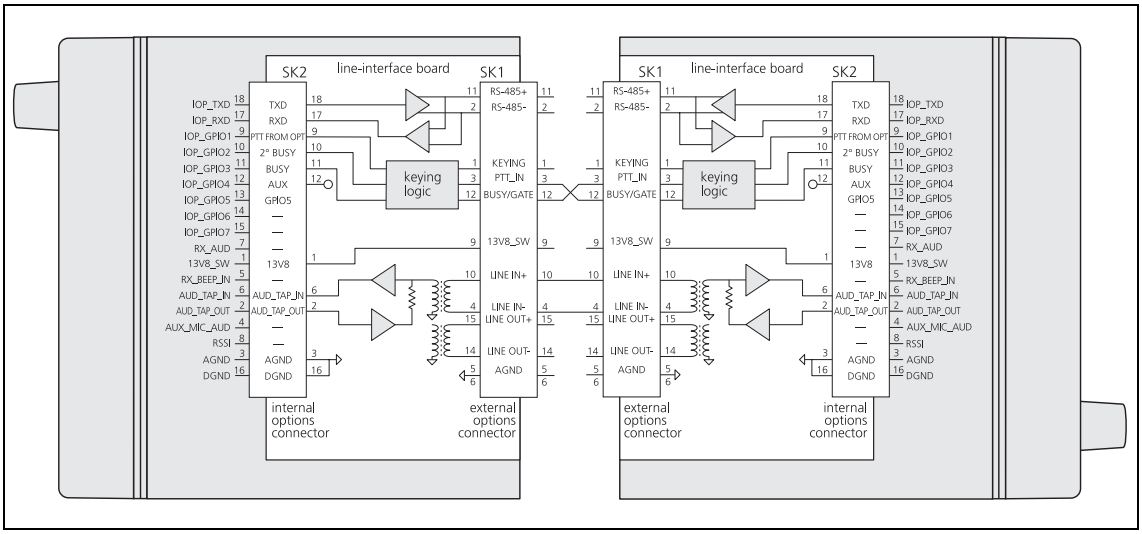


Pin	Signal	Description
1	KEYING	signal line keying
2	—	not connected
11	—	not connected
3	PTT-IN	bi-directional keying input
4	4W_LINE_IN -	4-wire line in negative
10	4W_LINE_IN +	4-wire line in positive
5	GND	ground
6	GND	ground
7	—	not connected
8	—	not connected
9	13V8 FROM RADIO	switched 13.8V supply from the radio
12	BUSY/GATE	Busy or receiver gate output. 5V CMOS logic level.
13	—	not connected
14	4W_LINE_OUT -	4-wire line out negative or 2-wire line in/out negative
15	4W_LINE_OUT +	4-wire line out positive or 2-wire line in/out positive

2.6 Line-Interface Board Application

The following diagram shows the control of two radios operated together, crossband or repeater linked.

Figure 2.3 Two radios connected as a repeater/crossband link



2.7 Line-Interface Board Specifications

Input Voltage	10.8V to 16VDC
Operating Temperature Range	-10°C to +60°C ambient
DC Input Current	<40mA total (+13.8V supply)
Line Input Sensitivity (60% deviation)	-20dBm to +6dBm (600Ω)
Line Output Level (60% deviation)	-20dBm to +6dBm (600Ω)
Line Impedance	600Ω
Return Loss (300Hz to 3kHz)	>20dB relative to 600Ω
Line Output Filter Response (stopband)	
2 pole	-12dB/octave, f >4kHz
6 pole	-36dB/octave, f >4kHz

2.7.1 Radio With Line-Interface Board: Receiver + Line Output

Receiver Frequency Response*	
Receiver Processed Bandwidth	300Hz to 3kHz (standard 400Hz to 3kHz (CTCSS)
Response	+1, -3dB relative to -6dB/octave
Receiver Unprocessed	+1, -3dB (300Hz to 3kHz)
*relative to 1kHz, 60% deviation	
Test Signal	-46dBm RF*, 0dBm line output, audio tap T4 *60% deviation at 1kHz
Signal-to-Noise Ratio	
Narrow Band	>40dB
Wide Band	>43dB
Mute Ratio	>60dB
Distortion*	
Narrow Band	<4%
Wide Band	<4%
*30kHz band width distortion meter	

2.7.2 Radio With Line-Interface Board: Receiver + Line Input

Transmitter Frequency Response*	
Bandwidth	300Hz to 3kHz
Response	+1, -3dB relative to -6dB/octave
*relative to 1kHz, 20% deviation, below limiting	
Test Signal	0dBm line input*, audio tap T1 *60% deviation at 1kHz
Signal-to-Noise Ratio*	
Narrow Band	>40dB
Wide Band	>43dB
*demodulated, filtered 300Hz to 3kHz and de-emphasised 750µs rms	
Mute Ratio	>60dB
Distortion*	<3%
*demodulated, filtered 15kHz low pass	

2.8 Circuit Description

2.8.1 Audio Interface

When the line-interface board is used for repeater applications, the audio passed between the two radios must be of such a level that the message is able to be repeated intelligibly. The audio interface is therefore capable of handling a wide range of input and output levels (-20 to +6dBm). The audio interface is also capable of using either a two- or four-wire isolated interface formats, which are selectable using S1.

The input to the line driver IC (U5) is the AUDIO TAP OUT line from the radio. This line is a software-programmabable tap point which can be chosen from various audio signals available within the radio and is coupled through a capacitor into the audio line out level control (RV2). This variable resister is AC coupled into the line driver (U5) which is used in a bridged-output format, with gain set to provide the necessary 21dB gain.

The resistors on the output of the line driver provides the necessary 600Ω terminating impedance, but also cause a 50% loss of signal. This is compensated for by the higher-than-necessary gain of the line driver. Line out protection is provided by two zener diodes, and the transformer (T1) provides isolation.

The audio interface is capable of using a two- or four-wire interface, so a tap is taken from one side of the balanced line out and is feed directly into the line input level control (RV3). When using a four-wire interface, the signal comes in through a second isolation transformer, T2. T2 is terminated with 600Ω and also acts as a voltage divider. This means that the signal level at RV3 will be identical to the level at RV3 when using a two-wire interface.

To achieve the required output level the non-inverting AC amplifier (U7) has a gain of 10, which provides the necessary 13dB of gain. The output of the amplifier is AC coupled into the AUDIO_TAP_IN line (pin 6 of SK2).

2.8.2 Logic Interface

The line-interface board is able to provide simple interface solutions with other radios. Logic is used to control keying of both radios as well as providing time delays to prevent squelch or cycling problems. The logic uses gates rather than discrete components.

The choice of which input controls BUSY/GATE can be selected using switches 3 and 4 of S1, while the sense of BUSY/GATE (pin 12 of SK1) can be selected using switches 5 and 6. Switch 7 accommodates either a two-line keying system or a single bi-directional keying line.

The comparators (in U1) operate off a single sided regulated 5V supply.

2.8.3 Power Supply

The power supply for the line-interface board comes from the radio via the internal options connector and is a 13.8V switched supply. Digital logic components are used in the line-interface board so there is a 5V regulator provided.

Initially the 13.8V from the radio is filtered and used for the audio line driver (U5) with reference to analogue ground. This 13.8V is also used to supply the 5V regulator, which is filtered separately for either 5V digital or analogue devices. A simple voltage divider is used to provide a 2.5V half-rail for the digital and a 2.2V rail for the analogue sections.

2.9 PCB Information

2.9.1 TMAA01-01 Parts List (PCB IPN 226-00124-04)

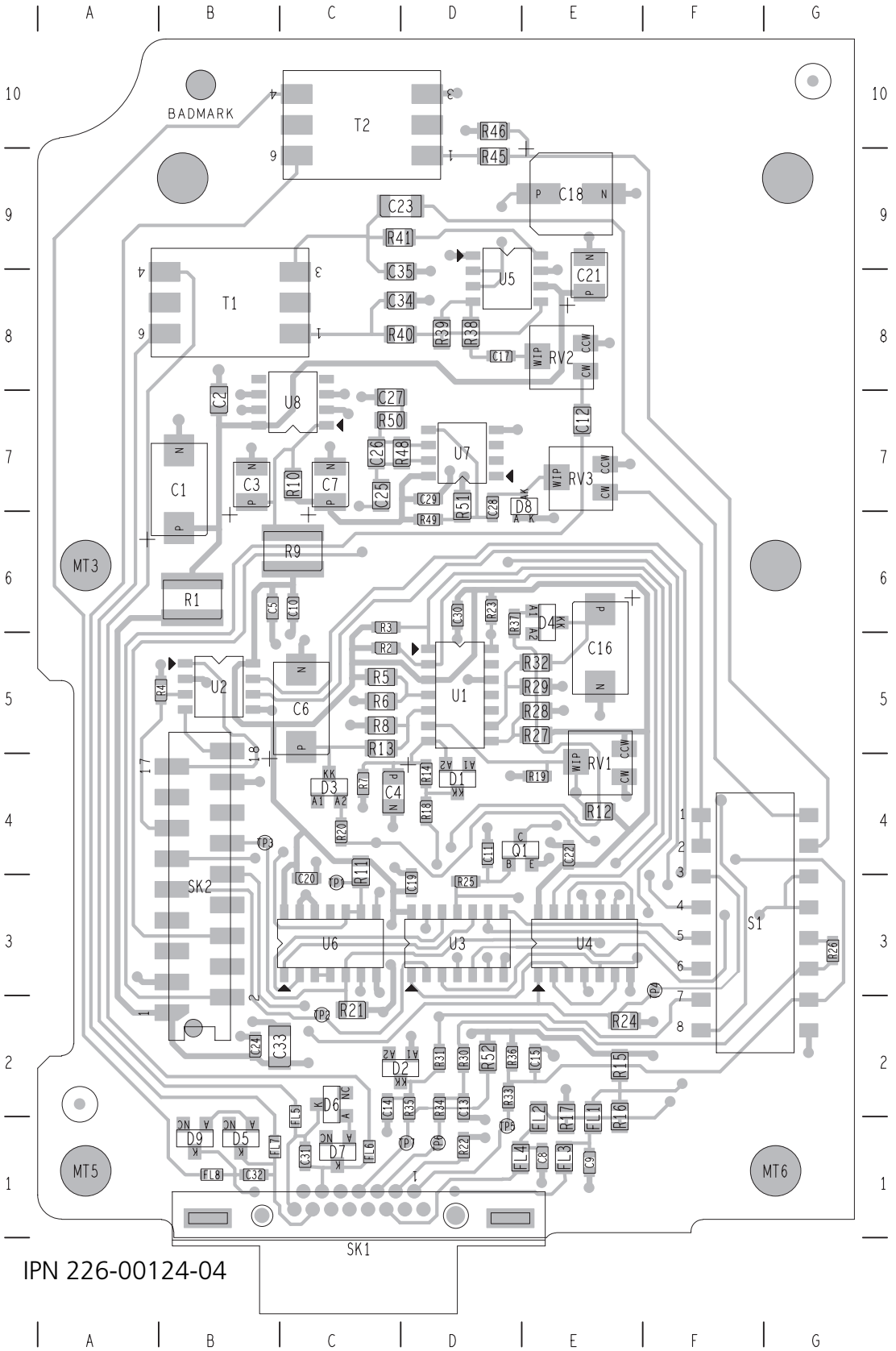
Ref.	IPN	Description
C1	014-08100-03	Cap Tant SMD 10u 35v 20% D
C2	015-26100-08	Cap Cer 0805 100n 10% X7r 50v
C3	014-07470-01	Cap Tant SMD 4u7 25v 10% B
C4	014-18100-05	Cap Tant SMD 10u 10v 10% A
C6	014-06220-00	Cap Tant SMD 2.2Mf 50v
C7	014-07470-01	Cap Tant SMD 4u7 25v 10% B
C10	018-16100-00	Cap 0603 100n 16vx7r+-10%
C11	018-15100-00	Cap 0603 10n 50v X7r +-10%
C12	015-26220-08	Cap 0805 220n 10% X7r 16v
C13	018-14100-00	Cap 0603 1n 50v X7r +-10%
C14	018-14100-00	Cap 0603 1n 50v X7r +-10%
C15	018-14100-00	Cap 0603 1n 50v X7r +-10%
C16	014-06220-00	Cap Tant SMD 2.2Mf 50v
C17	018-16100-00	Cap 0603 100n 16vx7r+-10%
C18	016-08470-01	Cap Elec SMD 47uf 6*4 16v
C19	018-15100-00	Cap 0603 10n 50v X7r +-10%
C20	018-15100-00	Cap 0603 10n 50v X7r +-10%
C21	014-07470-01	Cap Tant SMD 4u7 25v 10% B
C22	018-15100-00	Cap 0603 10n 50v X7r +-10%
C23	015-07220-08	Cap Cer 1206 2u2 16v X7r
C25	015-26330-08	Cap Cer 0805 330n 5% 10v X7r
C26	015-23150-01	Cap Cer 0805 150p 5% NPO 50v
C27	015-26330-08	Cap Cer 0805 330n 5% 10v X7r
C28	018-16100-00	Cap 0603 100n 16vx7r+-10%
C29	018-15100-00	Cap 0603 10n 50v X7r +-10%
C30	018-15100-00	Cap 0603 10n 50v X7r +-10%
C31	018-15100-00	Cap 0603 10n 50v X7r +-10%
C32	018-15100-00	Cap 0603 10n 50v X7r +-10%
C34	015-23470-08	Cap Cer 0805 470p 10% X7r 50v
C35	015-23470-08	Cap Cer 0805 470p 10% X7r 50v
D1	001-10000-70	Diode SMD BAV70 D-Sw SOT23
D2	001-10000-70	Diode SMD BAV70 D-Sw SOT23
D3	001-10000-70	Diode SMD BAV70 D-Sw SOT23
D4	001-10000-70	Diode SMD BAV70 D-Sw SOT23
D5	001-10084-51	Diode SMD BZX84C5V1 Zen SOT23
D6	001-10084-51	Diode SMD BZX84C5V1 Zen SOT23
D7	001-10084-51	Diode SMD BZX84C5V1 Zen SOT23
D8	001-10099-01	Diode BAV99w Dual Ss
D9	001-10084-51	Diode SMD BZX84C5V1 Zen SOT23
FL5	057-11220-02	Ind 0603 Blm11a221 Emi Supr
FL6	057-11220-02	Ind 0603 Blm11a221 Emi Supr
FL7	057-11220-02	Ind 0603 Blm11a221 Emi Supr
FL8	057-11220-02	Ind 0603 Blm11a221 Emi Supr
Q1	000-10084-82	Xstr BC848C NPN SS SOT23
R1	036-02100-03	Res 1218 10e 5% 1w PRC201
RV1	042-05100-05	Res Pre SMD 10k Cer 4mm Sq
R2	038-15100-10	Res 0603 10k 1/16w +-1%
RV2	042-05100-05	Res Pre SMD 10k Cer 4mm Sq
R3	038-15100-10	Res 0603 10k 1/16w +-1%
RV3	042-05100-05	Res Pre SMD 10k Cer 4mm Sq
R5	036-15820-00	Res M/F SMD 0805 82k 5%
R6	036-15470-10	Res M/F SMD 0805 47k 1%
R7	038-16220-00	Res 0603 220k 1/16w +-5%
R8	036-16120-00	Res M/F SMD 0805 120k 5%
R9	036-02100-03	Res 1218 10e 5% 1w PRC201
R10	036-13100-10	Res M/F SMD 0805 100e 1%
R11	036-14390-00	Res M/F SMD 0805 3k9 5%
R12	036-14330-10	Res M/F SMD 0805 3k3 1%
R13	036-16120-00	Res M/F SMD 0805 120k 5%
R14	038-16220-00	Res 0603 220k 1/16w +-5%
R18	038-14100-10	Res 0603 1k0 1/16w +-1%

Ref.	IPN	Description
R19	038-14270-00	Res 0603 2k7 1/16w +-5%
R20	038-15100-10	Res 0603 10k 1/16w +-1%
R21	036-14390-00	Res M/F SMD 0805 3k9 5%
R22	038-10000-00	Res 0603 Zero 0hm 1/16w +-5%
R23	038-15100-10	Res 0603 10k 1/16w +-1%
R24	036-14390-00	Res M/F SMD 0805 3k9 5%
R25	038-15100-10	Res 0603 10k 1/16w +-1%
R26	038-14100-10	Res 0603 1k0 1/16w +-1%
R27	036-15820-00	Res M/F SMD 0805 82k 5%
R28	036-15470-10	Res M/F SMD 0805 47k 1%
R29	036-16120-00	Res M/F SMD 0805 120k 5%
R30	038-13100-10	Res 0603 100e 1/16w +-1%
R31	038-14100-10	Res 0603 1k0 1/16w +-1%
R32	036-16120-00	Res M/F SMD 0805 120k 5%
R33	038-13100-10	Res 0603 100e 1/16w +-1%
R34	038-13100-10	Res 0603 100e 1/16w +-1%
R35	038-14100-10	Res 0603 1k0 1/16w +-1%
R36	038-15100-10	Res 0603 10k 1/16w +-1%
R37	038-15100-10	Res 0603 10k 1/16w +-1%
R38	036-15120-00	Res M/F SMD 0805 12k 5%
R39	036-16180-00	Res M/F SMD 0805 180k 5%
R40	036-13180-00	Res M/F SMD 0805 180e 5%
R41	036-13180-00	Res M/F SMD 0805 180e 5%
R45	036-13180-00	Res M/F SMD 0805 180e 5%
R46	036-13180-00	Res M/F SMD 0805 180e 5%
R48	036-16120-00	Res M/F SMD 0805 120k 5%
R49	038-16150-00	Res 0603 150k 1/16w +-5%
R50	036-15120-00	Res M/F SMD 0805 12k 5%
R51	036-16120-00	Res M/F SMD 0805 120k 5%
R52	036-16120-00	Res M/F SMD 0805 120k 5%
S1	230-10010-44	Sw SMD Spst 16dil X8
SK1	240-00011-67	Skt 15w Drng Ra Slim Dsub 7912
SK2	240-10000-11	Conn SMD 18w Skt M/Match
T1	054-00010-18	Xfmr Line SMD 600 Ohm P2781
T2	054-00010-18	Xfmr Line SMD 600 Ohm P2781
U1	002-10339-00	IC SMD LM339 4x CMplt S014
U3	002-10740-40	IC SMD 74AHCT04 S014 Hex Inv
U4	002-10740-80	IC SMD 74AHCT08 S014 4x2IP AND
U5	002-10854-10	IC TDA8541T 1w Audio Amp
U6	002-10740-80	IC SMD 74AHCT08 S014 4x2IP AND
U7	002-10003-58	IC SMD LM358 Dual 0-Amp
U8	002-10078-05	IC SMD 78l05 5v Reg
	226-00124-04	PCB TMA 600 Ohm Intfc
	365-00011-38	Lbl Static Warning Yel
	365-00011-54	Lbl White R1556/2 90*24mm
	399-00010-53	Bag Plstc 150*250mm
	399-00010-86	Bag Static Shlding 127x203mm
	410-01064-02	Pkg Hdr Card New Logo
600-00009-00 parts:		
	240-00010-80	Plg 15w Drng Hi-D
	240-06010-29	Conn 9w Hood/Cvr Lets
600-00010-00 parts:		
	219-00329-00	Loom TMA Int Opt
	354-01043-00	Fsnr Scrw Lok 1pr 4-40
	362-01108-01	Seal Drng Cvr 9way TMA
	362-01111-00	Seal Drng 9way TMA
	347-00011-00	Scrw 4-40*3/16 Unc P/P Blk
	349-02062-00	Scrw M3*8 T/T P/T ContiR

2.9.2 TMAA01-01 Grid Reference List (PCB IPN 226-00124-04)

Ref.	PCB	Circuit
C1	B6	1J2
C2	B6	1J2
C3	B6	1J4
C4	C3	1B5
C6	C4	1D5
C7	C6	1J4
C10	C5	1K4
C11	D3	1E9
C12	E6	1J3
C13	D1	1F12
C14	C1	1D12
C15	E1	1E12
C16	E4	1C9
C17	D7	1J6
C18	E8	1H7
C19	D2	1A9
C20	C2	1A9
C21	E7	1K8
C22	E3	1A10
C23	D8	1J9
C24	B1	1C12
C25	C6	1F2
C26	C6	1F3
C27	C6	1F4
C28	D6	1G4
C29	D6	1A12
C30	D5	1A11
C31	C0	1J13
C32	B0	1G13
C33	C1	1C13
C34	D7	1J9
C35	D7	1J9
D1	D3	1C6
D2	D1	1D12
		1E12
D3	C3	1D4
D4	E5	1C9
D5	B0	1G12
D6	C1	1J12
D7	C0	1J12
D8	E6	1F5
		1F4
D9	B0	1G12
FL1	E0	1B4
FL2	E0	1B4
FL3	E0	1B5
FL4	E0	1B5
FL5	C1	1J11
FL6	C1	1J11
FL7	B1	1G11
FL8	B0	1G11
Q1	D3	1E10
RV1	E3	1B5
R1	B5	1K2
RV2	E7	1J6
R2	C4	1D7
RV3	E6	1G5
R3	C5	1C3
R5	C4	1D5
R6	C4	1D5
R7	C3	1B5
R8	C4	1D5
R9	C5	1K3
R10	C6	1K4
R11	C3	1E3
R12	E3	1C4
R13	C4	1D5
R14	D3	1C6
R18	D3	1C6
R19	E3	1B4
R20	C3	1D4
R21	C1	1E2
R22	D0	1H13
R23	D5	1C7
R24	E1	1H4
R25	D2	1E9
R26	G2	1F8
R27	E4	1C9
R28	E4	1C9
R29	E4	1C9
R30	D1	1F10
R31	D1	1E11
R32	E4	1C9
R33	D0	1F12
R34	D1	1F12
R35	D1	1E12
R36	D1	1F11
R37	D5	1C10
R38	D7	1J6
R39	D7	1J7
R40	D7	1J8
R41	C8	1J8
R45	D8	1G10
R46	D9	1G10
R48	D6	1F3
R49	D5	1G4
R50	C6	1F4
R51	D6	1F4
R52	D1	1E13
SK1	D0	1H13
		1B13
		1G13
		1E13
		1F13
		1C13
		1J13
S1	F2	1F8
SK2	B2	1F1
		1G1
		1B1
		1D1
		1J1
		1A1
		1K1
		1E1
TP1	C2	1D2
T1	B7	1J10
TP2	C1	1H2
T2	C9	1G11
TP3	B3	1F3
TP4	F2	1H4
TP5	D0	1F12
TP6	D0	1G12
TP7	D0	1E12
U1	D4	1C4
		1D6
		1C8
		1A11
U3	D2	1G3
		1D9
		1A9
		1C11
		1F8
		1C7
U4	E2	1D8
		1G3
		1G4
		1A10
U5	D7	1J7
U6	C2	1D3
		1A8
		1C10
U7	D6	1A12
		1F3
U8	C6	1K3

2.9.3 Line-Interface Board Layout (top side)



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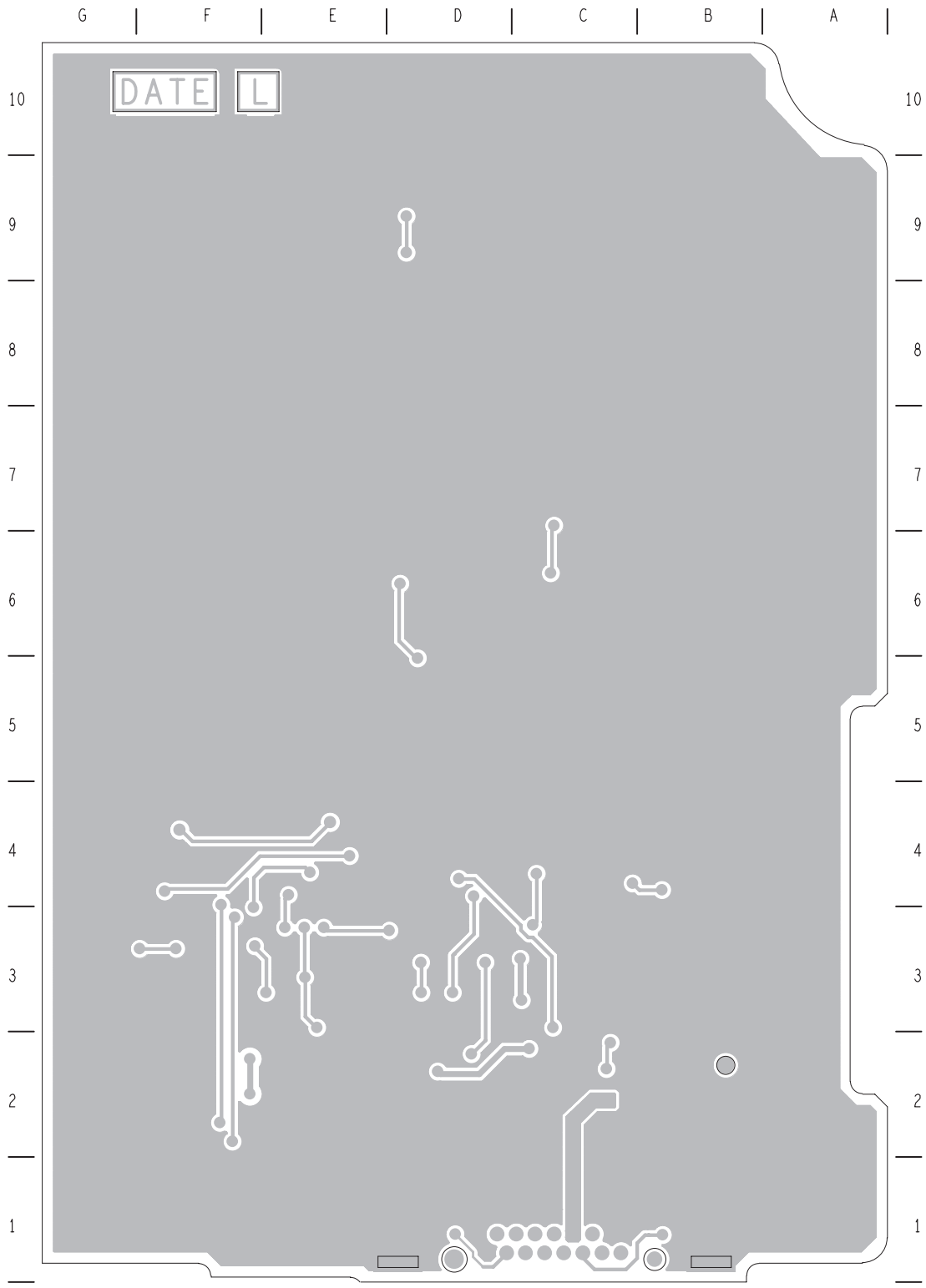
2.9.4 Line-Interface Board Layout (bottom side)



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2.9.5 Line-Interface Board Circuit Diagram