

**KU17**  
**V.21 CARD MODEM**

TECHNICAL MANUAL

14.4.2000

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## 1.0 INTRODUCTION

The KU17 Card Modem is a complete FSK Modem transmitter and receiver complying with CCITT recommendation V.21. It can operate at 0 - 300 baud full duplex on a 4-wire line or a 2-wire line. The mode of operation is set by on-board switches.

The data interface is V.24/RS-232.

KU17 needs one DC Power Supply, 8 - 60 V. The all CMOS design exhibits very low power consumption.

The modem features an adjustable RTS to CTS delay (2 ms - 200 ms).

The function of a modem is to allow data transfer between two distant digital based system. A one modem from the modem pair is selected to the originate mode and the another modem to the answer mode. The choice is selectabled with switch S2/3 (originate mode) or S2/4 (answer mode)

The modem receives data to be transmitted in a serial digital form and converts it to an analogue signal suitable for transmission over telephone lines. Conversely, it receives analogue signals transmitted from the distant station and converts them back to digital form.

The technique used is Frequency Shift Keying (FSK) modulation. In this system two frequencies "F+" and "F-" are used with continuous phase to represent the digital levels "0" and "1".

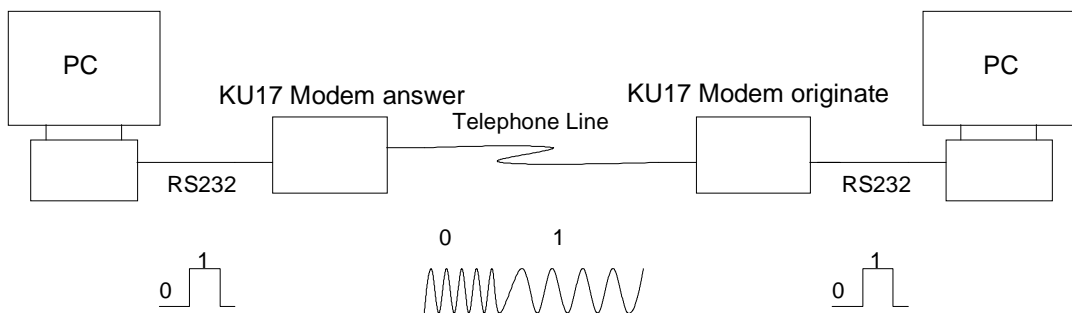


Figure KU17-1

## 2.0 CIRCUIT DESCRIPTION

The heart of this modem is the MSM7510 integrated circuit. This is a single chip modem and uses switched capacitor filtering technique in both transmit and receive filters.

### 2.1 Data Interface

Control signals and data are passed to the modem via V.24/RS-232 interface. The input and output signals are termed as follows:

Input Signals		Output Signals	
TRANSMIT DATA	TxD	RECEIVE DATA	RxD
DATA TERMINAL READY	DTR	DATA SET READY	DSR
REQUEST TO SEND	RTS	CLEAR TO SEND	CTS
		DATA CARRIER DETECT	DCD

### 2.2 Modem Control

The connection to the computer is done with straight cable, which has control signals according to the V.24 interface.

Computer		KU17 Card Modem
TxD	2	→ 2
RxD	3	← 3
RTS	4	→ 4
CTS	5	← 5
DSR	6	← 6
GND	7	— 7
DCD	8	← 8
DTR	20	→ 20

Eithet DTR or RTS can connect the Carrier. The choice is made with Switch S3 as follows:

- S3 on position 1, DTR connects the Carrier
- S3 on position 2, RTS connects the Carrier (factory setting)
- S3 on position 3, the carrier always active

The KU17 has one on-board optoisolated solid state relay, which can be used to control the transmitter on wireless connections. Either RTS or DTR controls the relay. The relay can be also closed or opened. The indicator TX is on when the relay is closed.

The relay's output switch is bidirectional and can drive max. 315 mA (load voltage range 0 to 100 V).

The KU17 Card Modem features an adjustable RTS to CTS delay, from 2 ms to 220 ms. When RTS raises, the CTS raises after the delay and informs the computer that the transmission can be performed.

The delay is adjusted with the trimmer R4. As a factory setting it is at 30 ms (Note! Mark on the trimmer R4).

The control line DCD is asserted when the modem detects a - 43 dBm (or greater) level of received in a band energy.

**2.3 Data Transmission**

Assuming the modem has been activated as detailed in section 2.2, the transmitter section will be operating. The input data to the transmitter (TxD) should be a logic 1 to transmit a MARK frequency or a logic 0 to transmit a SPACE.

Baud Rate	Transmitter Frequency in originate mode	
	MARK "1"	SPACE "0"
300	980 Hz	1180 Hz

Baud Rate	Transmitter Frequency in answer mode	
	MARK "1"	SPACE "0"
300	1650 Hz	1850 Hz

The transmit and receive levels are fitted to the operational amplifier N2. The transmit level is adjustable with the trimmer R5 and the switch S2/1 or S2/2. On a 4-wire mode the receive level is adjustable with the trimmer R6. As a factory setting the transmit level is at value -10dBm.

The choice between 2-wire and 4-wire connection is made by switches S1 as follows:

- S1 on position 1 4-wire connection
- S1 on position 2 2-wire connection



A lower transmit level can be chosen with the switch S5, for the e.g. radio use. The normal transmit level is adjusted to the -10 dBm by the trimmer R10 and switch S2/1. If the switch S5 is connected, the transmit level reduces to the -40 dBm. On the 4-wire connection the receive line can be terminated with 600 ohms switch S4.

The lines of the modem are well protected against line transients. The modem is isolated from the line with 600 ohms line transformers, which are EN41003 approved. At the primary side of the line transformers are gas tube arresters and at the secondary side transient suppressor.

**2.4 Indicators**

The KU17 Card Modem has six (6) LED indicators for the most important signals. Indicators are on when signal is active.

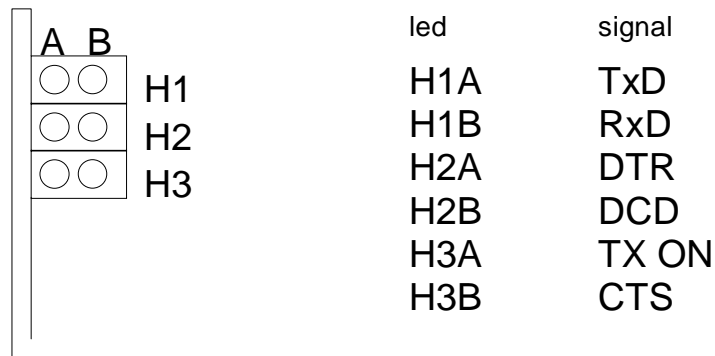


Figure KU 17-2

**2.5 Power Supply**

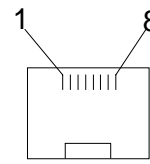
All the logic used in the modem operates at 5 VDC. A switching voltage regulator is used to provide the required 5 VDC supply voltage, so the input voltage can be at range 8 - 60 VDC. The modem is protected with diodes from the transients and false connections. The all CMOS design exhibits very low power consumption.

**2.6 KU17BOX Connections**

KU17BOX is a plastic case for one KU17 Modem. The functions are the same as at the other models. In the KU17BOX there are 6- and 8-pin Modular Jack-connectors for the telephone and serial lines. With the Modem we deliver 3 m long cables, which are described as follows.

**RS-232 Line Connection**

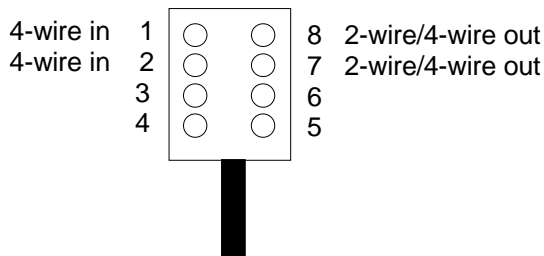
KU17BOX	Signals	D-25S
1	GND	7
2	CTS	5
3	DSR	6
4	CD	8
5	RTS	4
6	DTR	20
7	RxD	3
8	TxD	2



KU17BOX front view

**Telephone Line Connection**

KU17BOX	Signals	Connection Box
1	NC	
2	4-wire, IN	1
3	4-wire, IN	2
4	2-wire/4-wire, OUT	8
5	2-wire/4-wire, OUT	7
6	NC	





### 3.0 MODEM ADJUSTMENTS AND SETTINGS

The KU17 Card Modem has several adjustments

- RTS to CTS Delay Adjustment
- Transmit Level Adjustment and switches S1 - S5.

#### 3.1 *RTS to CTS Delay Adjustment*

The delay is adjusted by the trimmer R4. The factory setting 30 ms is marked with line at the trimmer. The delay is adjustable from 2 ms to 220 ms. The exact delay time measurement and adjustment can be done e.g. by watching signal RTS and CTS with oscilloscope. RTS is raised and the time until the CTS raises is the delay.

The RTS to CTS Delay is handy to adjust with the KUUMIC's MODTST-test program and RING TIMER-tester. The modem and the tester are connected to the computer's serial line and the test program is started. The Delay test is chosen by the F5, after that the delay can be seen continuously and it is easily adjustable with the trimmer R4.

#### 3.2 *Transmit Level Adjustment*

The transmit level adjustment is made by the trimmer R5 and switch S2. It is measured from the connector X2:ac3 and ac4 (or over the gas tube arrester V11). The factory setting is -10 dBm (approx. 245 mVAC).

The receive level of a 4-wire connection is adjustable from the trimmer R6. The level is measured on the test point TP3. The factory setting is made the way that the level on the test point TP3 is equal to the level from the connector X2:ac5 and X2:ac6 (or over the gas tube arrester V12).

#### 3.3 *Switches and Trimmers*

##### **Switches**

- |    |                 |
|----|-----------------|
| S1 | Line connection |
| 1  | 4-wire mode     |
| 2  | 2-wire mode     |

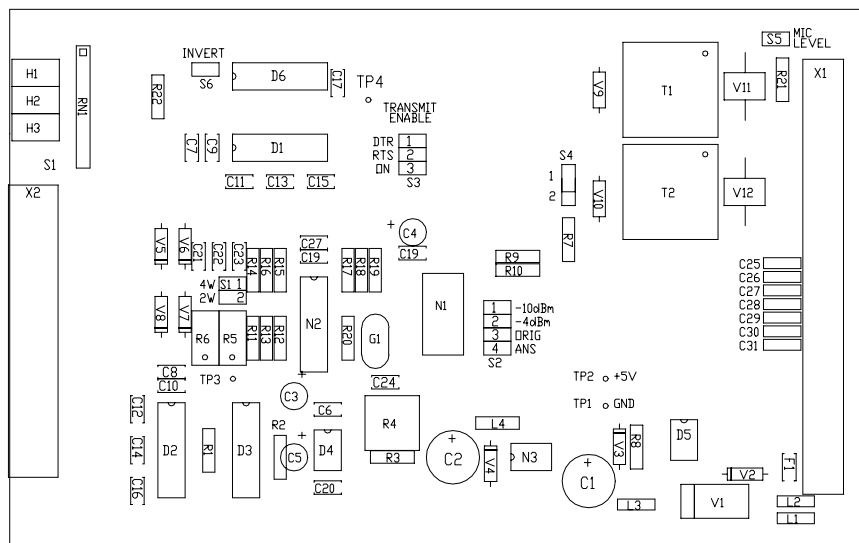
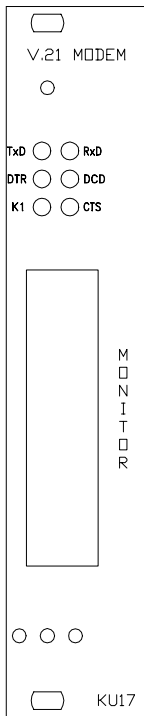
- S2 Mode select
  - 1 -10dBm transmit level
  - 2 -4dBm transmit level
  - 3 Originate mode
  - 4 Answer mode
  
- S3 Transmit Enable
  - 1 DTR connects the Carrier
  - 2 RTS connects the Carrier
  - 3 Carrier is allways connected
  
- S4 Receive Impedance
  - ON 600 Ohm
  - OFF High Impedance
  
- S5 Transmit level
  - ON Mic level for radio use only
  - OFF Normal use
  
- S6 RS-232 polarisation
  - ON Inverted RS-232 levels
  - OFF Normal RS-232 levels

**Trimmers**

- R4 RTS to CTS Delay (2 - 200 ms)  
Factory setting 30 ms marked
  
- R5 Transmit Level
  
- R6 Receive Level of a 4-wire mode

APPENDIX A

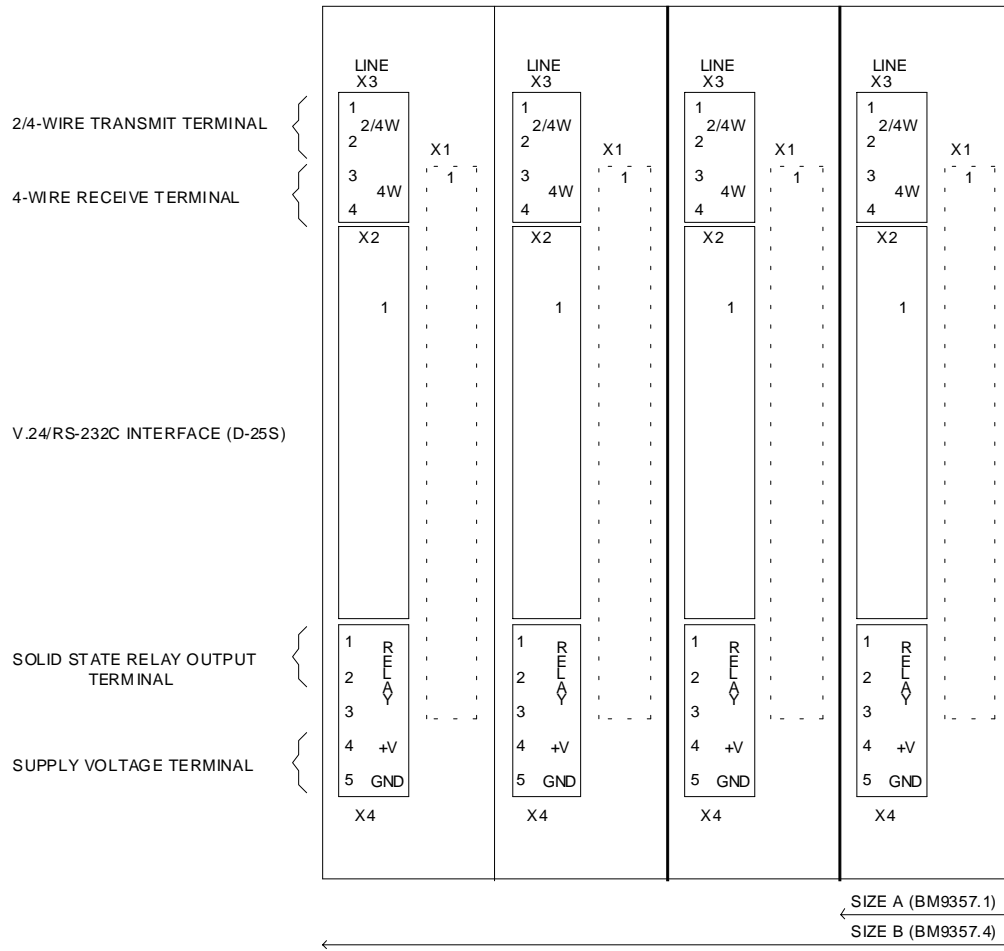
The layout of the KU17



- S1 2/4-WIRE CONNECTION
  - 1 4-WIRE CONNECTION
  - 2 2-WIRE CONNECTION
- S2 MODE SELECT
  - 1 -10 dBm TRANSMIT SIGNAL AMPLITUDE
  - 2 -4 dBm TRANSMIT SIGNAL AMPLITUDE
  - 3 ORIGINATE MODE
  - 4 ANSWER MODE
- S3 TRANSMIT ENABLE SELECTION
  - 1 DTR SELECT
  - 2 RTS SELECT
  - 3 ALWAYS SELECTED
- S4 INPUT IMPEDANCE SELECT
  - 1 HIGH IMPEDANCE
  - 2 600 ohm
- S5 TRANSMIT LEVEL SELECT
  - ON MIC LEVEL FOR RADIO USE ONLY
  - OFF NORMAL USE
- S6 RS-232 POLARISATION
  - ON INVERTED RS-232 LEVELS
  - OFF NORMAL RS-232 LEVELS

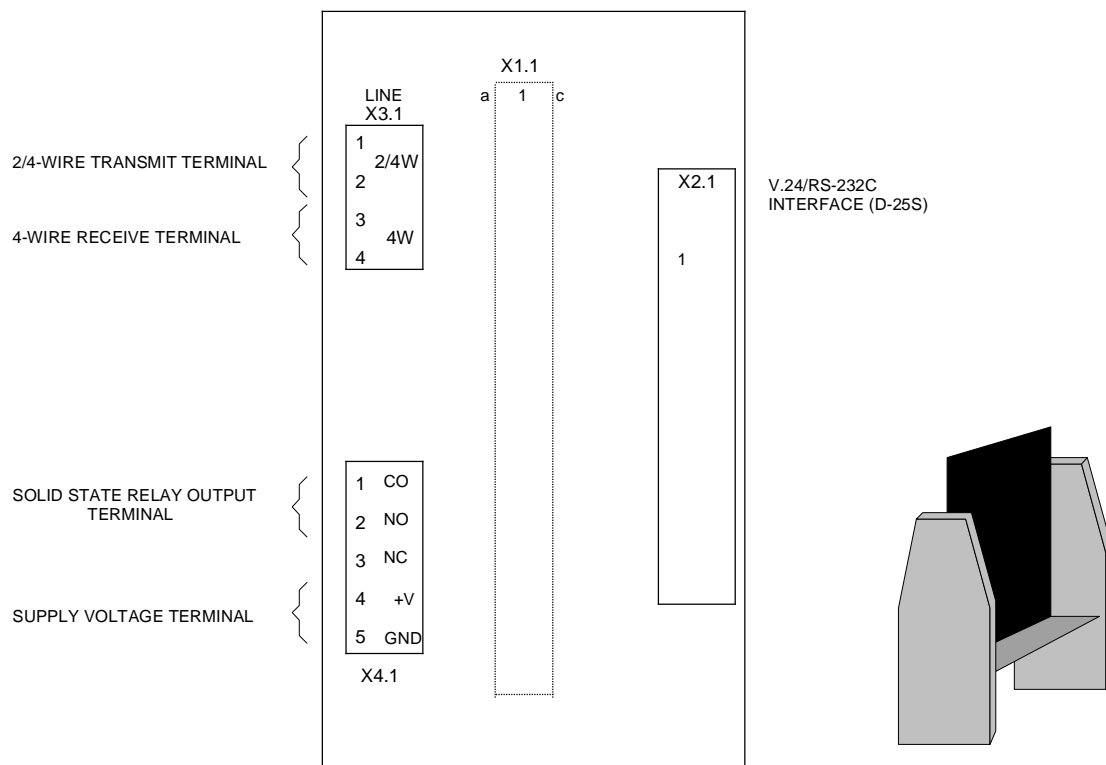
APPENDIX B

Backplane BM9357 layout



## APPENDIX C

### The layout of the KU20.1 card holder

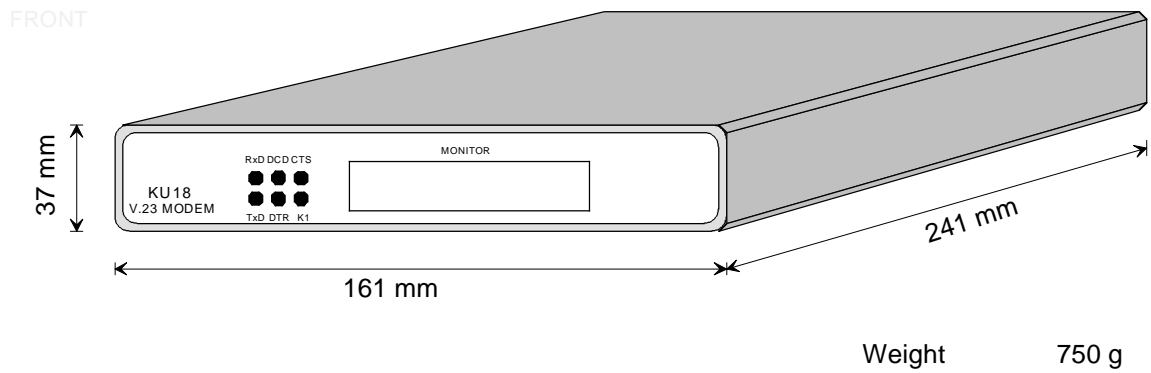


KU20.1

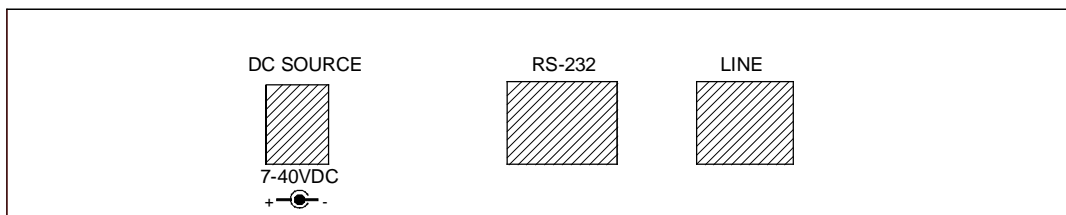
Backplane of the KU20.1

APPENDIX D

KU17BOX



Backpanel of the KU17BOX



APPENDIX E

Backplane BM9437 layout

