In the development of the LT 2 S the demand was made for a low noise receive-converter and also a high level signal handling capability, along with low inter-modulation signal products.

To achieve these results it was necessary to deviate from comon circuit practices. Therefore the first stage uses a microwave GaAs-Fet, which is selected for a high IDSS value. By having a high resting current (about 40 - 50 mA) and a suitable output network using a ferrite transformer, the first stage achieves a 3rd order intercept point (IP) of +10 dbm (referred to the input) for a noise figure of F $\leq$ 0.8 db.

As a modulator a passive Schottky diode ringmodulator with a very low intermodulation distortion (TAK-1H) is used, which lowers the overall IP to about 6 dbm.

Experiments with super high current mixer(local oscillator level +23 to +27 dbm respectively) showed that the following diplexer with the high current Fet "F 8002" could not handle the passed input IP anymore.

An improvement of the diplexer using parallel switched Fets and toroid transformers on the output raises the overall IP of the transverter to +10 dbm.

Referred to the output, that means a 3rd order IP of +32 dbm.

Unfortunately for these very good values there is not yet any suitable shortwave receiver available.

At present in amateur radio an IP of +16 dbm is state of the art. Therefore the simple version with the TAK-1E is used, which still achieves a very good output, ir of about +26 dbm.

The system intercept point of a 2 meter station, equipped with a LT 2 S, is only defined by the shortwave transceiver.

A Schottky ring mixer is used as a balanced modulator, driven by a weak attenuated signal, followed by 2 class A amplifiers, which are operated at most 20 % of maximum power.

This signal with very few distortions (in the 3 db band width more than 40 db, in the 5 db band width more than 70 db) is fed into the 2 stage power amplifier, which is limited to 20 watts. However the amplifier is capable of approximately 50 watts.

Up to about 10 watts PEP the amplifier works in a pure class A mode. The intermodulation values of the LT 2 S are very good, however there is a distinct degree of the 5 db and 7 db product.

The data shows surprising similarity with measurements that were done with good tube power amplifiers because of the very clean output signal the LT 2 S is very good feeding 2 meter high power amplifiers.

The following 2 stage harmonic filter supresses the 1st harmonic by at least 60 db, the 2nd harmonic by at least 70 db.

The LT 2 S has a built-in antenna relay to directly connect the antenna cable. By resoldering of a jumper, it can also be operated with separate outputs for transmit and receive. In the 10 meter transmit input, a variable attenuator is used which allows input signals from - 10 ... + 27 dbm.

Further features: switchable shift (-600 khz), illuminated watt meter.

LT 2 S Operating hints

By using high tech measuring instruments, like spectrum analyzers, noise gain analysers, wattmeters etc., the LT 2S has been carefully calibrated and checked. Therefore the calibration settings should not be altered, otherwise this would result in deterioration of the parameters.

Power Supply

To get low intermodulation distortion in transmit mode, the LT 2 S needs stabilized operating voltage of 13.8 – 14.2 volts. The voltage drop on the cable has to be adjusted by measuring the voltage at the LT 2 S.

When using the LT 2 S at a lower voltage (for example in a car) the output power has to be reduced by adjusting the 10 meter attenuator. Operating the LT 2 S at 12 volts, only about 12 watts HF can be achieved without much intermodulation distortion.

Connectors on the Back

The transverter comes with 2 BNC connectors for the SW transceiver. The connector "10-m out" is to be connected to the receiver input of the transceiver by using a coax cable. The transverter output of the transceiver (low power output) is to be connected to the connector "10-m in". This input can be fed with signals between 0.1 and 500 mW (-10... +27 dbm)

The built-in variable attenuator can be reached by a hole in the back of the transverter. The attenuator has to be adjusted, so that the built-in power meter shows an output power of 20 watts when feeding the LT 2 S with a carrier (FM or CW constant signal)

With a SSB signal the power meter may only indicate 5 watts, however on voice peaks (PEP) will produce up to 20 watts (PEP). In this manner the linearity of the transmitted signal can be maintained.

LT 2 S Operating Hints

On the 2 meter side the transverter has 2 female N-connectors, however only the connector "Antenna" is used for receive and transmit.

For working with a operate coax cables for transmit and receive, the connector "HF Out" must be activated. Therefore open the case by loosening 2 screws on each side and changing of 2 jumpers on the system board near the antenna relay "SMS ST-1".

1. Remove the relay operating voltage by cutting jumper "A".
2. Close jumper "B-C" by using a piece of wire. Thereby the HF signal goes directly to the connector "RF-Out".

The split mode over seperate transmit-receive cables has its advantages. You can use any power amplifiers and pre-amplifier without having a coax relay switch. There is only one good coax relay (HF 400 2s, with coil R.K. 500) near the antenna. From there, there are 2 seperate coax cables to the station.

With longer cables you should use an additional pre-amp near the antenna relay. This can be connected to the RX output of the coax relay by using a double N connector.

You should only use special pre-amps of the newest generation with a good noise figure (less than 1 db), good intercept point (at least + 6 dbm related to the input) and low gain.

The gain should be adjustable and should be selected to just compensate for cable loss.

Therefore the very good noise figure and the good large signal handling capability is maintained.

The mentioned special pre-amp is available from us, starting July 1987.

LT 2 S Operating Hints

Transmit-Receive switching

The Transmit-Receive Switching of the transverter is done by the P.T.T. signal coming from the SW transceiver. The inner contact of the P.T.T. connector (Cynch-female connector) on the back of the LT 2 S must be connected to ground for transmitting

The switch "TX" on the front of the set is parallel to that connector and allows manual transmit-Receive switching.

In Split mode with seperate coax cables, the coax relay near the antenna receives its operating voltage via the coax-cable when receiving. This can also be used to power a pre-amp.

For transmitting, this voltage must be switched off completely. (Therefore you can use a contact of relay 1 in the LT 2 S). When the coax relay opens, the power to the pre-amp is switched off and the transmitting path to the antenna is clear. If using the coax relay "HF 400" with additional contacts, a power amp may be switched on with these contacts. This guarantees that the P.A. is activated after the coax relay has switched to Transmit!

Repeater Shift

For operating with a 2 meter transverter the LT 2 S has a built-in repeater shift. When transmitting, a built-in 2nd crystal oscillator works with a shift of 600 KHZ. You turn on the repeater shift by switching to "Duplex".

Warning: by using the switch in the wrong way, you could exceed the lower band edge up to 600 KHZ.

Continuous Operation

The excellant linearity of the power amp has been achieved by using high resting currents of the power transistors.

LT 2 S Operating Hints

The heat is dissapated by cooling fins. In any case these may not be covered to not interrupt the necessary air circulation.

For contest operation at higher temperatures, the use of a fan may be necessary.

It is interesting to note that early experiments were conducted utilizing super high level double balanced mixers (200mW at the LO port) and parallel P8002's. Output 3rd order intercept points of +32dBm were acheived. Since current state of the art amateur HF radios have typical 3rd order intercept points of +15dBm, the use of a high level DBM and a single P8002 still exceeds the capability of the HF tranceiver. In reality, the HF radio now becomes the limiting factor. When you consider the alternative of using a modern VHF or UHF transceiver that has a typical 3rd order intercept point (at the input) of -15dBm, the choice becomes quite clear very quickly. The use of your HF radio and one of our LT Series transverter systems will clearly outperform any multi-mode/multi-band transceiver manufactued today.

Transmit section overview

The same care that was given to the design of the receive section, has been carried forward into the design of the transmit section. The 28MHz RF signal is routed via an attenuator network to a low level double balanced Shotkky passive mixer to produce the desired mix of the local oscillator and 28MHz. drive signal. The output of the mixer is amplified by two filter coupled Class A amplifiers which operate at only 20% of their maximum output. These pre-driver amplifiers acheive a 3rd order IMD difference of more than 40 dB. The 5th order IMD product difference is better than 70 dB. This signal is then fed to a two stage power amplifier block to acheive the rated 20 watt output level. The saturation power of this block is approximately 50 watts. Up to the 10 watt PEP level, this amplifier operates in a pure class A mode which is comparable to the best tube amplifiers.

TECHNICAL DATA

Transmit Section

Input Frequency	28 - 30 MHz.
Output Frequency	144 - 146 MHz.
Drive Power (internally adj.)	.1mW - 500mW
Output Power	20W

Receive Section

Input Frequency	144 - 146 MHz.
IF Frequency	28 - 30 MHz.
Noise figure	1.0 dB
Conversion Gain	typ 20 dB

General

Power requirements	13.8VDC
Current drawn on receive (transmit)	0.2A (4.0A) typ.

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General

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Current drawn on receive (transmit)..	0.2A (4.0A) typ.

LT28 Connection and operating instructions

Front Panel controls:

Switch "ON"	Provides power to the transverter, the LED indicator should light.
Switch "TX"	This switches the transverter to transmit under manual control.
Switch "SIMS/DUP"	In the simplex mode, both the receive and transmit frequencys will be the identical. In the duplex mode, a second local oscillator is selected during transmit thus allowing an RPT transmit offset. This feature is particularily useful in Europe where repeater sub-bands also occupy the low end of each band. To utilize this feature a crystal must be purchased for the second local oscillator. SSB Electronic USA can modify this feature to permit IF QSY for contest operators. Contact us for more information.
Power Output	The watt meter indicates the actual power output. (50 Ohm Pure Load)

Rear Panel connections

ANTENNA (N)	An "N" connector is provided for 144MHz RF In/Out
RF OUT (N)	An additional "N" connector is provided that will allow you to split the 144MHz RF In/Out signal paths. This feature can be used to eliminate an external linear amplifier input relay thus avoiding an additional relay along with its associated losses. Before using this feature, a simple modification must be made! Refer to "Spliting the RF IN/OUT signal paths" for additional details.
+13.8V	Connect to your power supply using a large diameter power cable (to avoid voltage drop). To acheive the full 20 watt power output you will need a power supply capable of delivering 13.8 volts @ 5.0 amps.
-	Connect to the minus side of your power supply.
PTT	This phono connector provides a connection to the transverters PTT Line. A ground on this line places the transverter into transmit mode.
28MHz In (BNC)	Apply 28MHz. drive to this connector. Do not exceed 500mW of RF power.
28MHz Out (BNC)	IF (receive) output is available at this connector. Do not apply RF power to this connector.

Input attenuator adjustment:
The LT2S has a built-in attenuator for matching 28MHz. drive levels up to .5 Watts. Matching to your HF Radio can be accomplished as follows:

Remove the upper half of the case of the LT2S (four screws), and place the back of the transverter toward you. An access hole is provided for attenuator adjustment between the two BNC connectors. Using a suitable trimmer tool, carefully insure that the attenuator rotator is at the maximum counter clock-wise position (Maximum attenuation). Insure that the ANTENNA connector is terminated in a good quality dummy load, then place the transverter and your HF radio in the transmit position. Rotate the attenuator rotor clockwise for 20 watts output as indicated on the power meter.

Using the second Oscillator:
The second Local oscillator can be used for RPT offset by installing an additional crystal into the empty crystal socket. A series resonant 5th overtone crystal is required.

Crystal Frequency = (144.0MHz + or - OFFSET) - 28.0MHz

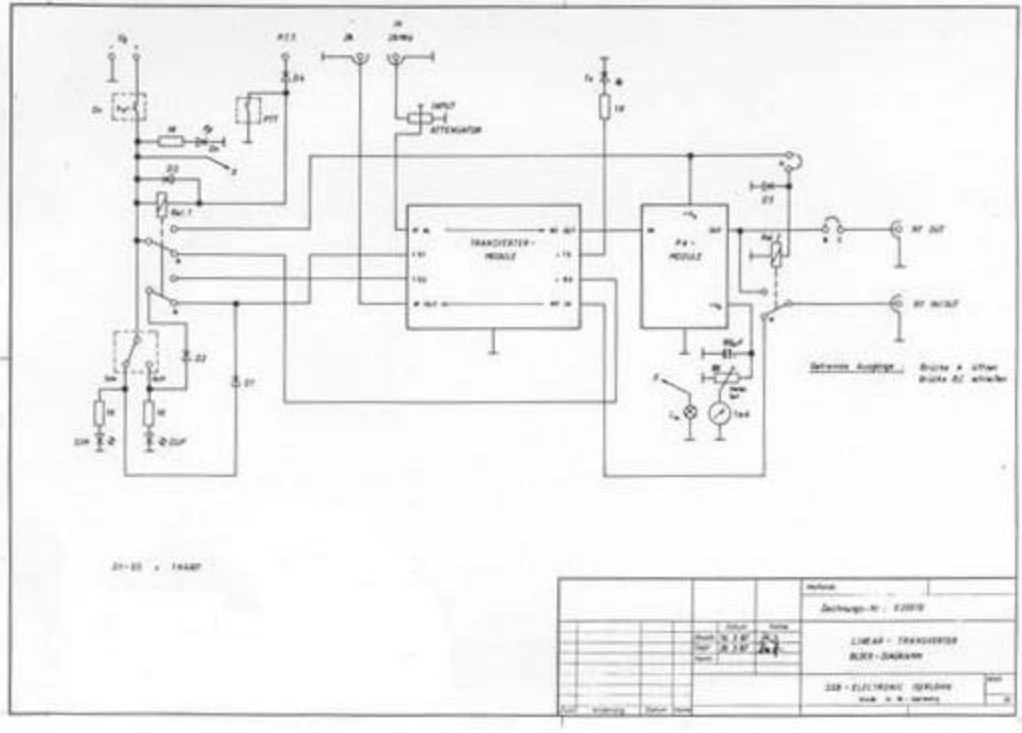
For example, if a 600KHz plus offset on transmit was required, the a 116.6MHz crystal would be required.

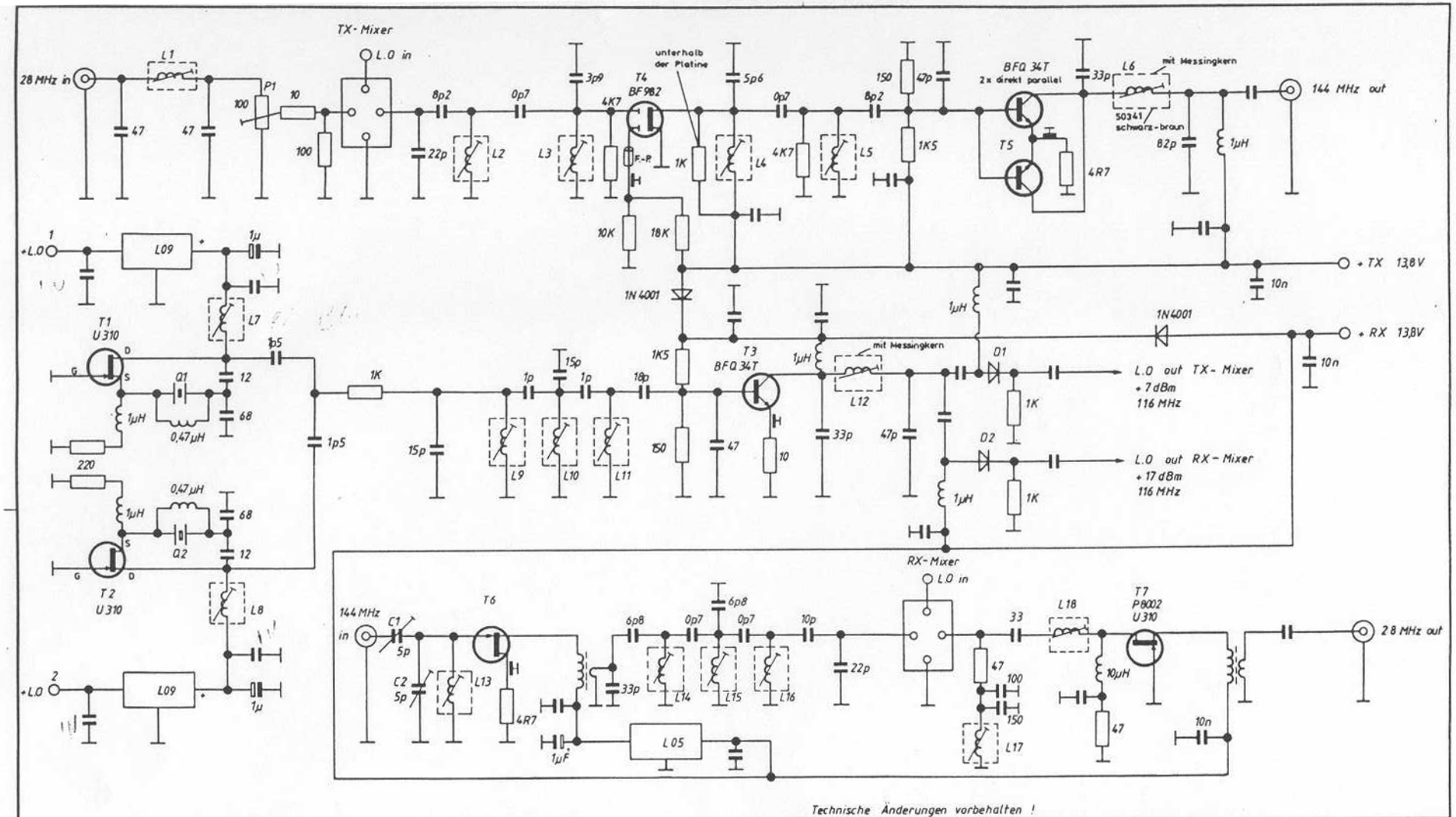
116.6MHz. = (144.0MHz + 600KHz) - 28.0MHz.

Splitting the RF IN/OUT signal paths
As shipped, RF IN/OUT are common to a single type "N" connector labeled - ANTENNA. The following simple modification will allow the type "N" connector labeled - ANTENNA to function as an isolated receive port and the type "N" connector labeled RF-OUT to function as an isolated RF-OUTPUT port. It is essential that a grounded tip soldering iron be used to carry out this modification. Remove the bottom cover, and place the back of the transverter away from you. Notice in the top left corner ther are three circut board traces labelled: "A", "B" & "C". Remove the solder bridge at trace "A", and then bridge across the traces labelled "B" & "C". (A small brass tab works great!) Your transverter will now be functional with separate transmit and receive ports.

Should you ever have any questions concerning your LT2S, please do not hesitate to contact us.

73's
Gerry Rodski K3MKZ
SSB ELECTRONIC USA


INPUT
ATTENUATOR
TRANSVERTER-
MODULE
PA-
MODULE
RF OUT
RF IN/OUT
Zeichnungs-Nr.: 0.0010
LINEAR - TRANSVERTER
BLOCK - DIAGRAMM



Technische Änderungen vorbehalten !

Q1	=	116.000 MHz
L1	=	5049 gelb - weiß
L2 - L16, L17x	=	5061 braun - blau
L18x	=	5046 gelb - blau
L19x	=	5048 gelb - grau
D1, D2	=	BAV 20

alle nicht bezeichneten Kondensatoren = 1nF

x = ohne Abschirmbecher (without shielding), Abschirmbecher entfernen (remove shielding of these coils)

	Datum	Name
Bearb	16.4.87	Ri.
Gepr	22.4.87	Bart
Norm		

Maßstab

Zeichnungs - Nr. : 20020

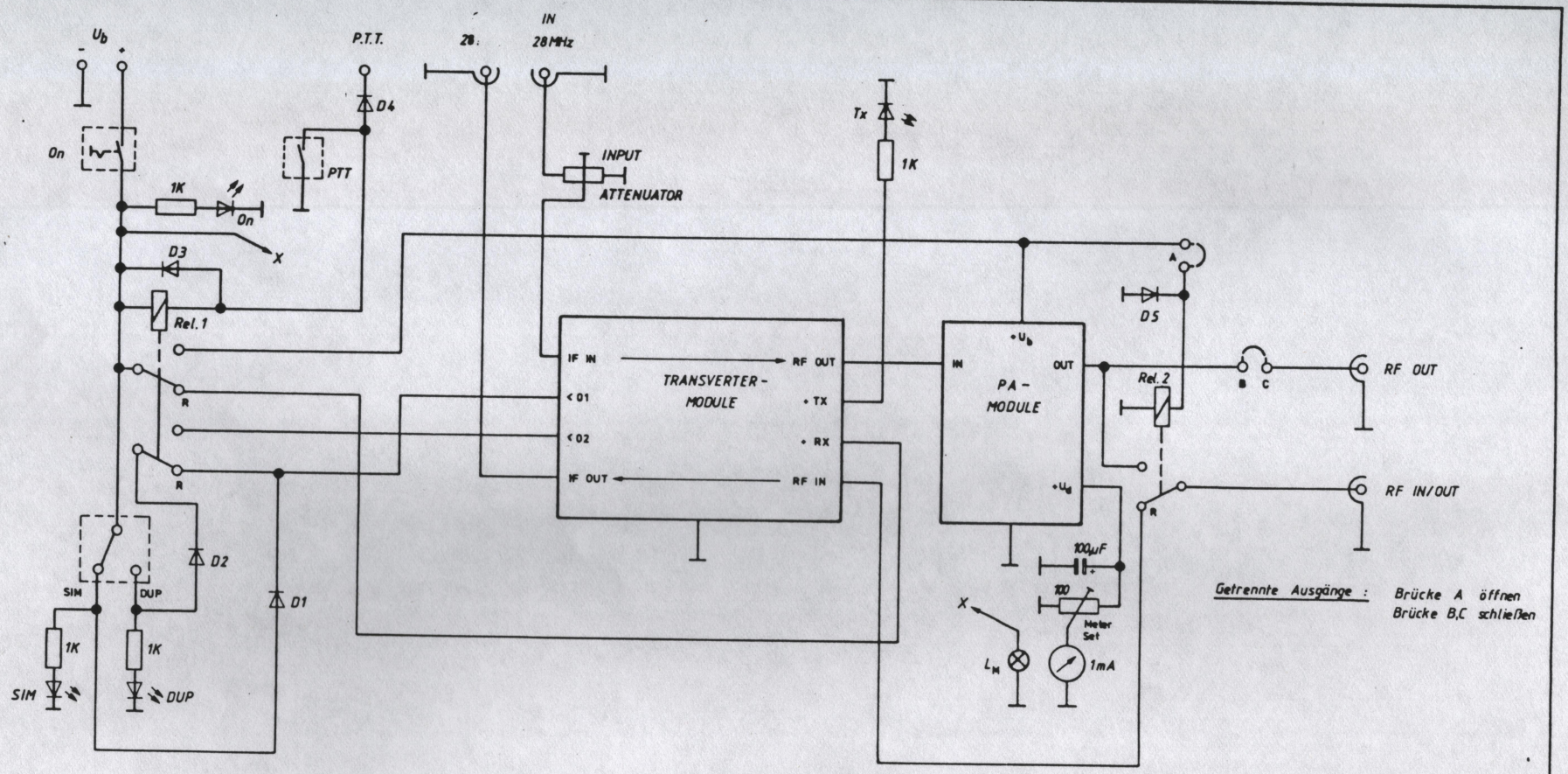
LT 2 S - TRANSVERTER MODULE

SSB - ELECTRONIC ISERLOHN

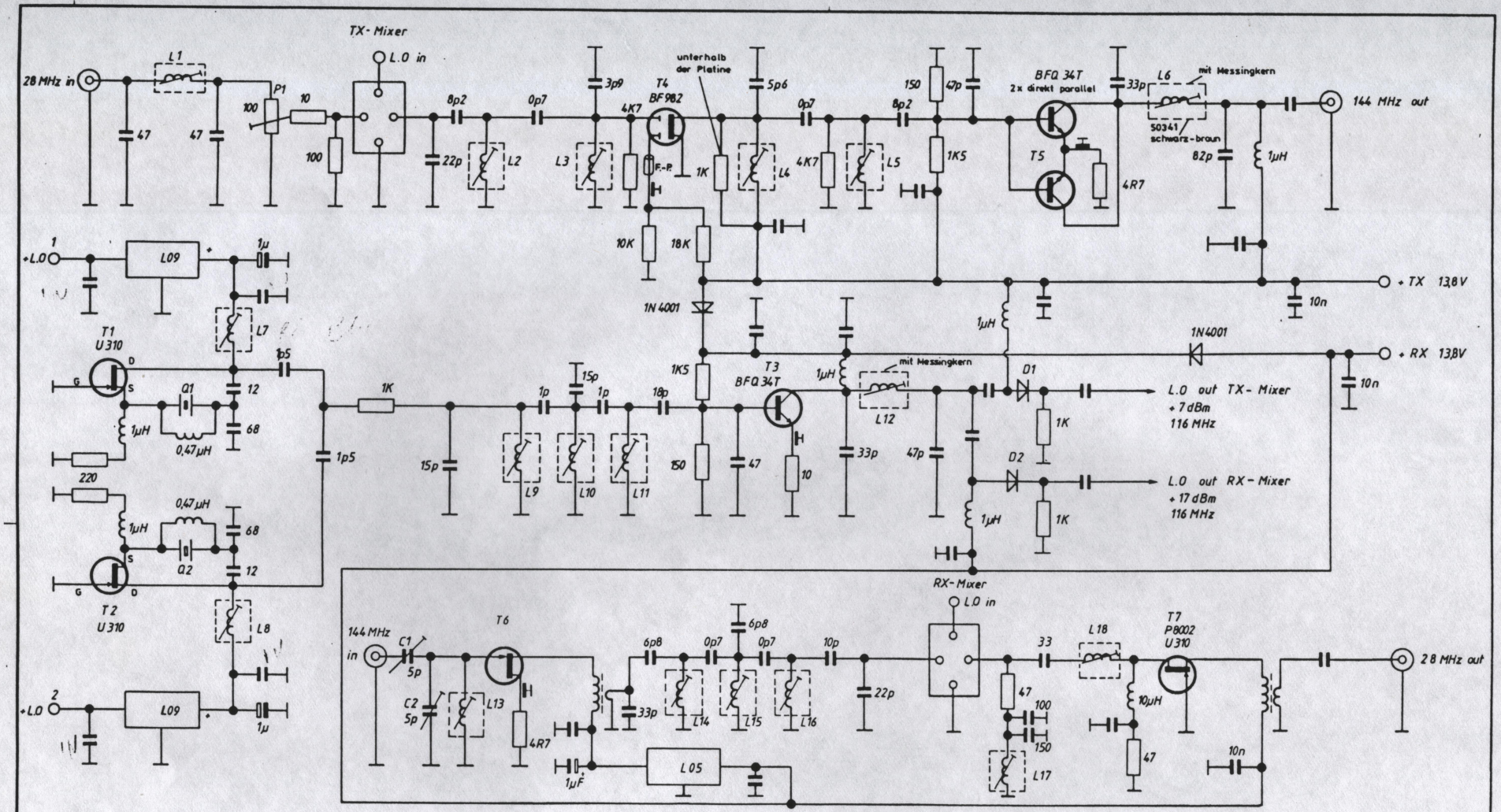
Made in W- Germany

Blatt 81

Zust	Änderung	Datum	Name



					Maßstab	
					Zeichnungs-Nr.: 020010	
				Datum	Name	
			Bearb	16.3.87		LINEAR - TRANSVERTER
			Gepr	20.3.87		BLOCK-DIAGRAMM
			Norm			
					SSB - ELECTRONIC ISERLOHN	Blatt
					Made in W.-Germany	Bl
Zust	Änderung	Datum	Name			



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Technische Änderungen vorbehalten !

	Datum	Name
Bearb	16.4.87	Ri.
Gepr	22.4.87	Bart
Norm		

Maßstab

Zeichnungs - Nr. : 20020

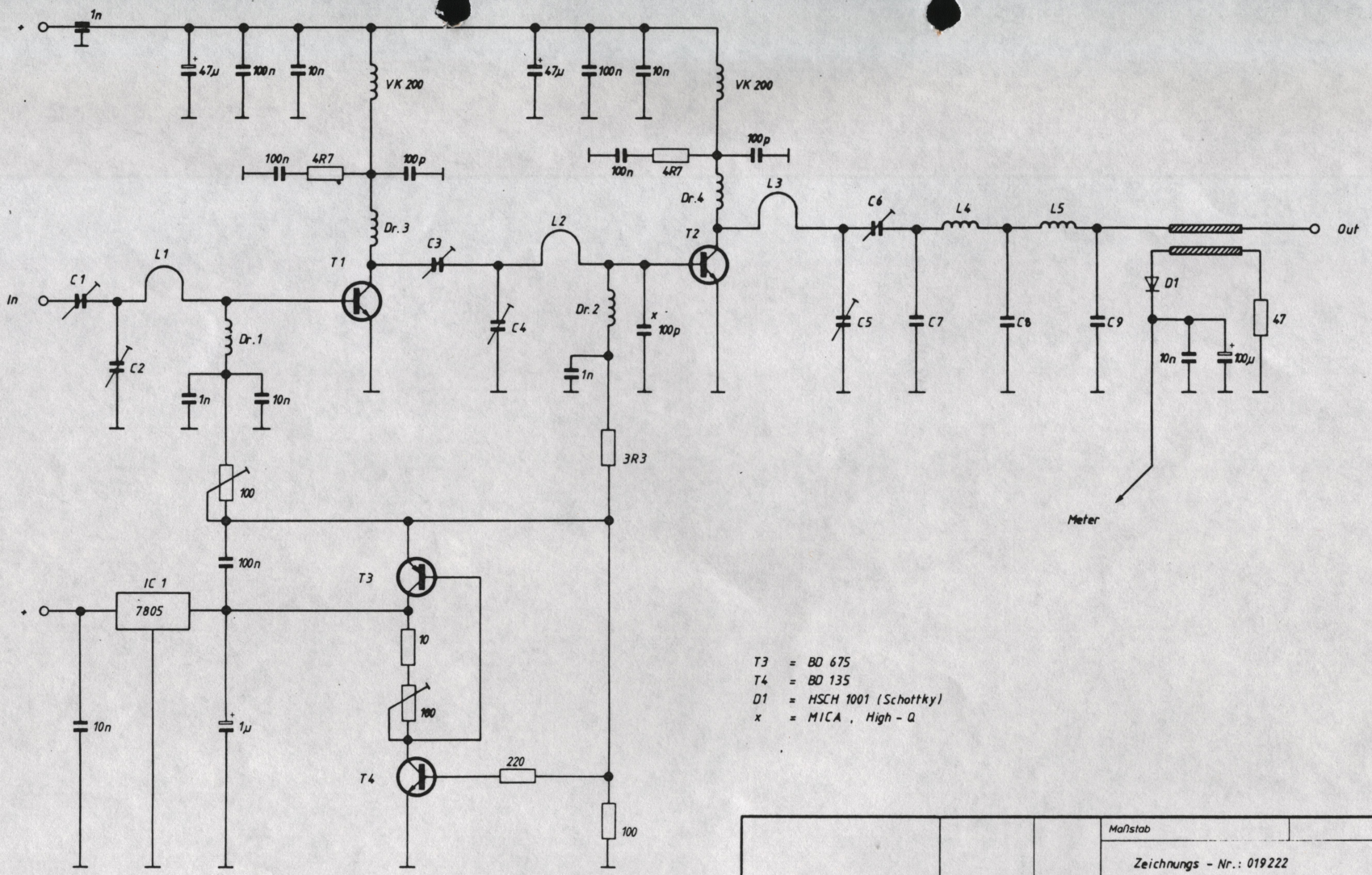
LT 2 S - TRANSVERTER MODULE

SSB - ELECTRONIC ISERLOHN

Made in W.- Germany

Blatt 81

Zust.	Änderung	Datum	Name



T3 = BD 675
T4 = BD 135
D1 = HSCH 1001 (Schottky)
x = MICA , High - Q

						Maßstab	
						Zeichnungs - Nr.: 019222	
					Datum	Name	
				Bearb	5.3.87		Transverter PA - Board
				Gepr	10.3.87		
				Norm			
						SSB-ELECTRONIC ISERLOHN	Blatt
						Made in W.-Germany	Bl
Zust	Änderung	Datum	Name				