



ROHDE & SCHWARZ

Radio Communications Division

User Manual

LINE FLATTENER

FK 859C1

680.3013

LINE FLATTENER • FK 859C1

User Manual

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LINE FLATTENER
FK 859C1

User Manual
Part 1: Characteristics

- 1.1 -

1. Characteristics

1.1 Application

The Line Flattener FK 859C1 is part of the HF 850 family of 1-kW shortwave radio equipment.

tennas and wide-band dipoles) exhibiting a maximum VSWR (voltage-standing wave ratio) of 3.

The Line Flattener FK 859C1 is an optional unit of the 1-kW Transceiver XK 859C1. Its use is recommended where the 1-kW HF Transceiver XK 859C1 is operated with HF wide-band antennas (e.g. log-periodic antennas, cage an-

The Line Flattener FK 859C1 is micro-processor-controlled which ensures optimum impedance matching of the 1-kW HF transceiver in the frequency range of 1.5 to 30 MHz under all conditions.

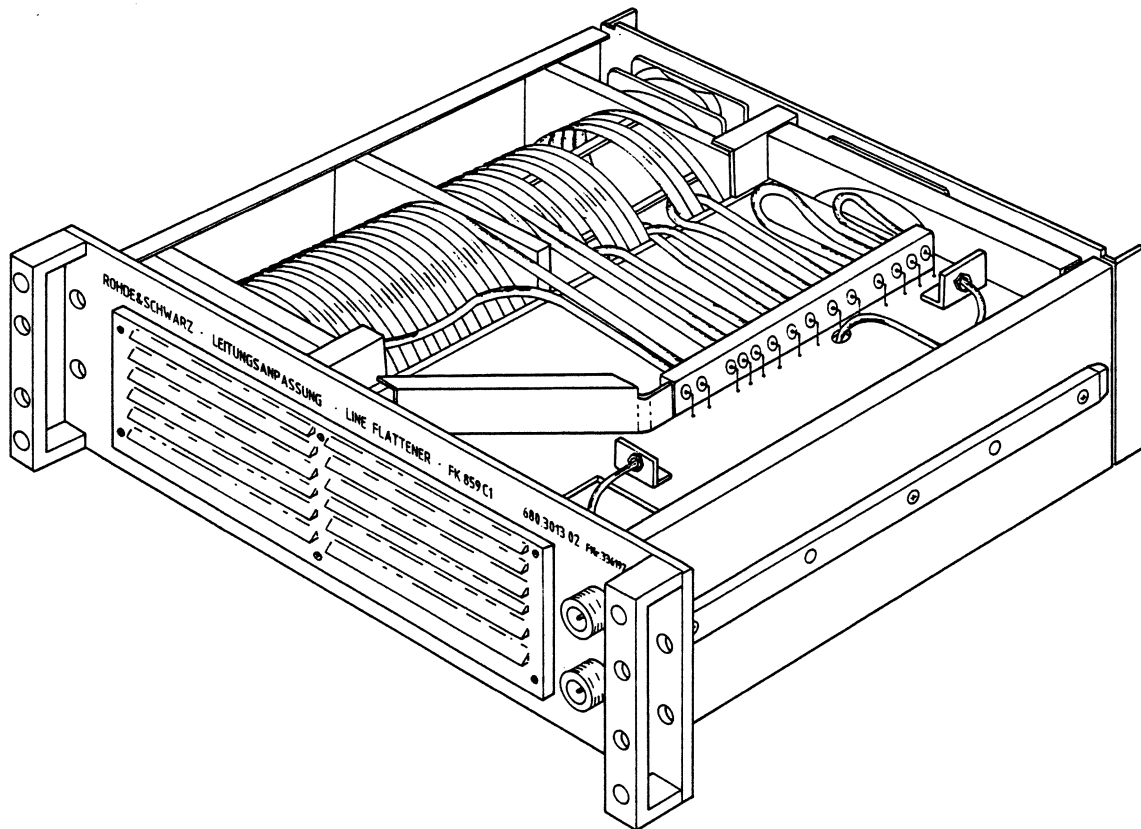


Fig. 1.1 Line Flattener FK 859C1

LINE FLATTENER
FK 859C1

User Manual

Part 1: Characteristics

- 1.2 -

1.2 Design and Functioning

1.2.1 Design

The Line Flattener FK 859C1 is housed in a fan-cooled 19"-plug-in rack-mount unit with three height units (132 mm).

The unit consists of a 19-inch aluminum frame and contains the assemblies listed below:

- o A1 Coil board, consisting of:
 - o A1.1 Coil PCB and
 - o A1.2 HF cable set, W1 to W7
- o A2 Capacitor PCB
- o A3 Tuning processor, consisting of:
 - o A3.1 Tuning controller PCB and
 - o A3.2 Processor PCB
- o A5 Cable W21
- o 2 Vane-axial ventilation fans

The front panel contains the air inlet that is covered with a louver. The HF sockets for the connection of the 1-kW Amplifier VK 859C1 and of the antenna are contained at the right-hand side of the front panel.

A locking device screw-mounted to the left cover prevents the line flattener from dropping out of the rack when loosening the four screws with which the unit is attached to the rack.

At the rear panel, two vane-axial ventilation fans are mounted beside each other that are covered with circular protective grills.

Connector X50 through which control signals and supply voltages are applied to the line flattener is mounted at the left side of the rear panel.

All assemblies may be separated from each other by disconnecting the respective flat cable connectors.

A filter (Z10) is connected between the 24-VDC input and successive circuitry. This filter is mounted to the inner wall of the rear panel next to connector X50.

Coil board A1 is mounted at the top of the unit. It contains the relays for switching the binary-stepped cables W1 to W7, that are combined in the cable set. Additionally, balancing networks W8 and W9 as well as two temperature sensors are contained on the coil PCB A1.1.

Cable set A1.2 is installed on the left in the air duct of the line flattener. Cables W1 to W7 are wound in a single layer on their winding forms and are secured with cable binders and cable clamps. All wire ends of the cables are solder-connected on the coil board.

The capacitor PCB A2 is installed at the bottom of the unit. It contains the relays for the Tx/Rx switching, the relays for switching of the binary-stepped capacitors and the measuring head for measuring forward and reflected power as well as magnitude and phase of the antenna impedance that is to be matched. The capacitor PCB contains also a temperature sensor.

The tuning processor A3 is contained at the bottom side of the unit. It consists of the shielded tuning control circuitry with a DC-to-DC converter, relay drivers, level converters and an analog-to-digital converter. All signal and supply voltage lines as well as internal interface lines to the assemblies are routed via EMI filters. The separately shielded processor PCB is directly connected to the tuning control PCB via connectors X64 and X65.

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1.2.2 Functioning

The impedance transformation performed in the Line Flattener FK 859C1 is microprocessor-controlled and ensures optimum impedance matching of the 1-kW Transceiver XK 859C1 to wide-band antennas with a VSWR not exceeding $S = 3$.

This means for the 1-kW Amplifier VK 859C1 that its 50-ohms output will always be matched to the input impedance of the line flattener with a resulting VSWR of $S \leq 1.3$.

The load impedance as seen by the line flattener, consisting of the antenna impedance and the impedance of the connection cable, is always transformed to a real component of 50 ohms and the resulting inductive reactance ($50 \text{ ohms} + jX$) by insertion of lines with binary stepped lengths. To achieve optimum impedance matching, the remaining inductive reactance is compensated by insertion of series capacitances that are also binary-stepped.

The time required to obtain optimum impedance matching (tuning time) does not exceed 5 s. The typical value for the tuning time is, however, approx. 1 s. In the line flattener, 100 channel-related parameters entered via the Control Unit GB 853C1 can be stored in a non-volatile memory. During channel operation, the tuning time is approx. 20 ms.

The CPU (central processing unit) of the tuning control circuitry consists of an 8085 microprocessor, an EPROM

(erasable programmable read-only memory) program memory in which the tuning algorithm is permanently stored and a non-volatile RAM (read-and-write memory) in which the tuning parameters for 100 channels, once determined, can be stored. The assembly contains also the relay drivers that energize and deenergize the relays. A 3.4-V lithium battery is used as the backup voltage source for the RAM in the microprocessor in case of mains power failure or if the system is switched off.

Buffer amplifier N30 converts the signals received from the HF measuring head that describe the current impedance conditions into the levels required by the analog-to-digital converter D30.

When the maximum allowable operating temperature is exceeded, the signals provided by the three temperature sensors contained in the unit cause the HF output power of the 1-kW HF Transceiver XK 859C1 to be reduced to 300 W and an error message to be output.

Furthermore, the unit contains the level converters required for data and signal communications with the XK 859C1 transceiver.

A DC-to-DC converter cooperates with the tuning control circuitry that converts the floating DC supply voltage of 19 to 31 V into the supply voltages of +5, -5 and +24 VDC for the line flattener.

LINE FLATTENER
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User Manual
 Part 1: Characteristics

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1.3 Technical Data

Frequency range 1.5 to 30 MHz

Maximum HF input power ≤ 1125 W

Minimum HF input power required for
 the impedance-matching procedure 100 W

Input VSWR (after tuning) $s \leq 1.3$ at 50 ohms

Maximum allowable VSWR at the output
 (antenna impedance of 50 ohms) $s = 3$

Insertion loss (dependent on frequency
 and load) approx. 0.5 dB

Time required for automatic tuning ≤ 5 s (1 s typical)

Time required for tuning with
 preselected channels approx. 20 ms

Number of preselectable channels 100

General Data

Temperature ranges

Operation temperature -25 to +55 °C

Storage temperature -40 to +85 °C

Power requirements 19 to 31 VDC (provided via
 the 1-kW HF Transceiver
 XK 859C1)

HF connectors N-type HF panel sockets

Electrical connections via cable W8 either in the
 Rack, Mobile KG 859C1 or in
 the Rack, Stationary KG 859C4

Dimensions

Width x height 483 mm x 132 mm

Depth behind front panel 451 mm

Mass approx. 15 kg

L I N E F L A T T E N E R
F K 8 5 9 C 1

User Manual
Part 1: Characteristics

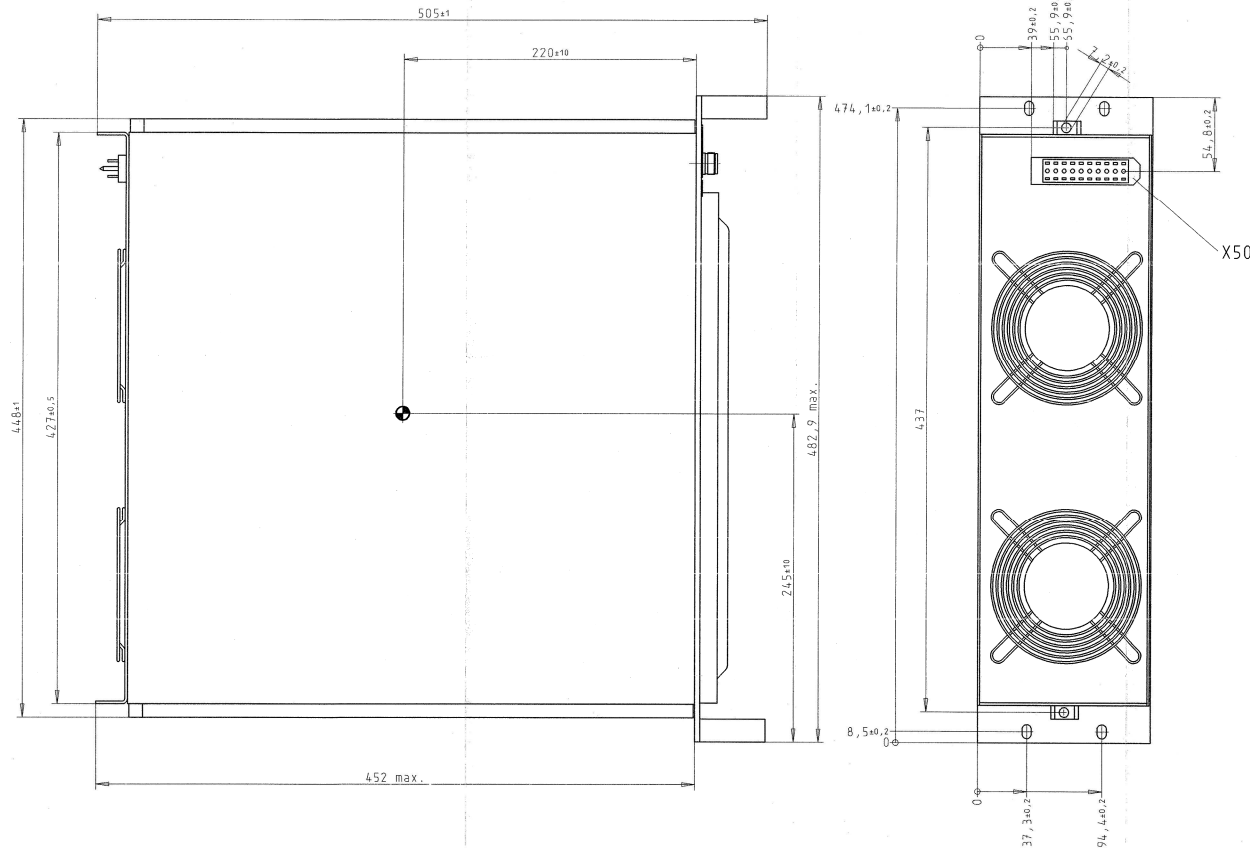
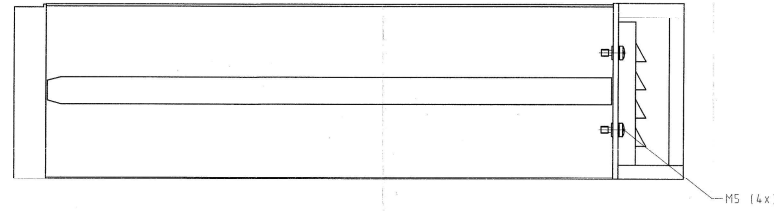
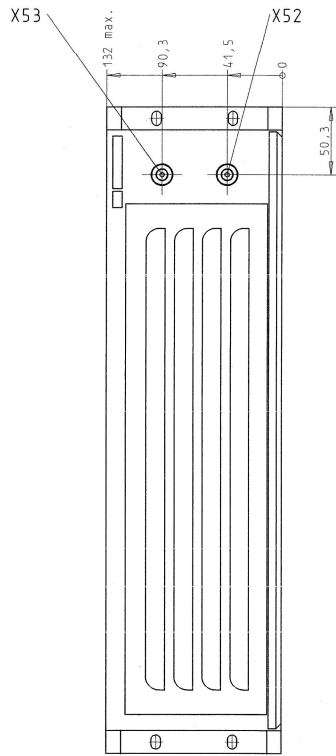
- 1.5 -

1.4 Models of the Line Flattener FK 859C1

The Line Flattener FK 859C1 is available in several models which differ only in their colours.

Models 02, 03, 04 and 11 are identified through the following colours:

- 02: RAL 7035 light grey,
- 03: RAL 6104 NATO olive,
- 04: RAL 7001 NAVY grey und
- 11: RAL 6031 HR bronze green



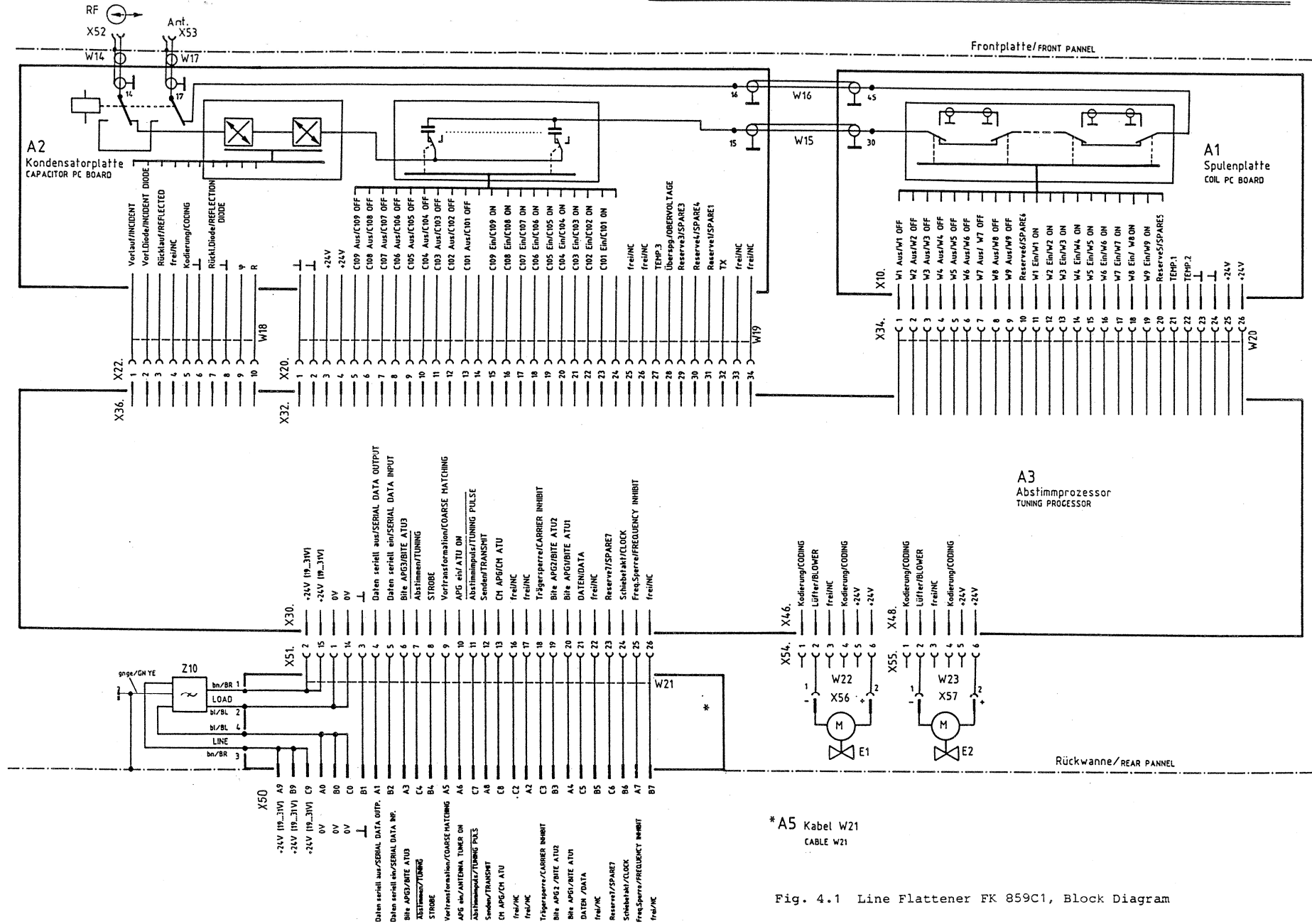
Einbauzeichnung

S = Schwerpunkt / CENTER OF GRAVITY
 (...) = Informationsmaß / ONLY FOR INFORMATION
 Masse : max. 15 kg / MASS : MAX. 15 kg

X50	AMPFENDL	T207004	
X52	SUMMER	ZSM-50-3-TC	
X53	SUMMER	ZSM-50-3-TC	
Pos.	Bezeichnung	z.B. Bestellbezeichnung / Hersteller	
DESIGNATION		e.g. ORDER DESIGNATION / MANUFACTURER	
		z.B. Separatstück	
		MATING CONNECTOR	
		Platzzahl	1 : 2
		Werkstoff	
01		ZWF	Bztlm
		Bezt.	19.05.92
		WV_SL	
		Bezeichnung	FK859C1 Leitungsanpassung
			LINE FLATTENER
		Bezeichnung	0680.3013.01
		Zeichn.-Nr.	
		Blatt-Nr.	03
		Blattanzahl	3
		Hersteller	ROHDE & SCHWARZ
		Teil-Nr.	FK859C1
		Fig.-L.V.	0680_3013
		01192 L	

Diese Zeichnung ist ein...
 Nur diese Zeichnung...
 Änderungen...

128-01010
 Maßstab 1:1
 BKS



* A5 Kabel W21
CABLE W21

Fig. 4.1 Line Flattener FK 859C1, Block Diagram

Für diese Unterlage behalten wir uns alle Rechte vor

Kennz. Comp.No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	VARIANTENERKL. / VERSIONS VAR 02 = RAL7035 LICHTGRAU VAR 03 = RAL6014 OLIV VAR 04 = RAL7001 MAR. GRAU VARIANTENERKL. / VERSIONS SOFTWARE- VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL				680.4110.01
A1	ZM SPULENPLATTE	680.3294.02			
A2	ED KONDENSATORPLATTE CAPACITOR PCB	680.3107.02			
A3	ZE ABSTIMMPROZESSOR	680.3494.02			
A5	ED KABEL W21 CABLE	680.3936.02			680.3913.01
A411	HS SOFTWARE BESTEHT AUS D3 CONSISTING OF D3 HIERZU STROML.680.3494.01S SEE CIRC.DIAG.680.3494.01S	680.4110.02			
E1	EV 119X119X25 47L/S 24V- FAN	586.9670	PAPST	4124 F	680.3913.01
E2	EV 119X119X25 47L/S 24V- FAN	586.9670	PAPST	4124 F	680.3913.01
W22	DX KABEL W22	680.3642			680.3913.01
W23	DX KABEL W23	680.3659			680.3913.01
W50	DX HF-KABEL 1KW	681.3230.02			
X54	BESTEHT AUS/CONSISTING OF EINSATZ FP458.0194 CODIERSTIFT FP418.0041 GEHAEUSE 566.1316				680.3642
X55	BESTEHT AUS/CONSISTING OF EINSATZ FP458.0194 CODIERSTIFT FP418.0041 GEHAEUSE 566.1316				680.3659
Z10	LD NETZFILTER 2A M.DR. LINE FILTER	LD 680.4210	CORCOM	2B3	680.3913.01 - ENDE -
ROHDE & SCHWARZ		AI	Schaltteilleiste für Parts list for		Sachnummer Stock Nr.
		Datum Date			Blatt Page
		04 0588	FKB59C1 LEITUNGSANPASSUNG LINE FLATTENER		680.3013.01 SA 1-

LINE FLATTENER
FK 859C1

User Manual
 Part 2: Preparation for Use and Operation

- 2.1 -

2. Preparation for Use and Operation

2.1 Preparation for Use

2.1.1 Installation of the Line
 Flattener into the Rack

For putting the Line Flattener FK 859C1 into operation it is to be connected to the 1-kW HF Transceiver XK 859C1.

Proceed as follows:



1. Remove the blanc panel (three height units) above the 1-kW Amplifier VK 859C1 from the Rack KG 859C1/C4.

Note:

If the optional line flattener is installed into the rack at a later time, disconnect X100 of cable W9 from mating socket X50 mounted inside the rack and insert connector X100 into the dummy connector ("parking position") at the upper left side inside the Rack KG 859C1/C4.

2. Put the line flattener onto the guide rails and push the unit in by approx. two thirds of its way.
3. Push the locking device at the left side of the line flattener's enclosure upwards that prevents the unit from dropping out of the rack.
4. Push the line flattener fully into the rack and secure the unit with

four captive screws to the front panel of the rack's frame. Connector X50 is automatically inserted into its mating connector.

5. Connect cable W50 to the HF output connector X67, RF  of the 1-kW Amplifier FK 859C1 and to the HF input connector X52, RF  of the line flattener.
6. Connect the coaxial 50-ohms cable from the wide-band antenna to the antenna output connector (X53, ANT.) of the line flattener.

2.2 Operation

The Line Flattener FK 859C1 contains no control elements.

It is operated by means of the Control Unit GB 853C1 which is part of the HF Receiver/Exciter GX 859C1, contained in the 1-kW HF Transceiver XK 859C1.

The line flattener is automatically set by the processor of the HF Receiver/Exciter GX 859C1, as well as by the built-in microprocessor that controls the tuning sequence.

LINE FLATTENER
FK 859C1

User Manual
 Part 4: Troubleshooting

- 4.1 -

4. Troubleshooting

4.1 General

A built-in self-test circuitry (BITE) of the Receiver/Exciter GX 859C1 continuously monitors all essential functions of the Line Flattener FK 859C1 and displays the current status at the Control Unit GB 853C1 or GB 858.

In the Line Flattener FK 859C1 the operating conditions "temperature", "insufficient forward power" and "excessive VSWR" are continuously monitored. If preset thresholds are exceeded, a CM (continuous monitoring) signal is output each time.

The "insufficient forward power" message leads to the tuning sequence being aborted. All other CM messages cause the HF output power of the transceiver to be reduced. In the frequency display of the control unit appears the error message "E" together with a code number.

By referring to the fault list enclosed in the user manual for the 1-kW HF Transceiver XK 859C1 it is then possible to carry out speedy repair.

4.2. Replacement of the Line Flattener FK 859C1

If, by referring to the fault list the line flattener has been definitely proved to be defective, e.g. with a $VSWR \geq 3$, the unit is to be sent for repair.

Perform the removal and installation of the line flattener according to 2.1.1.

4.2.1 Memory Backup Battery

Only negligible current is drawn from the lithium battery installed in the processor that provides the supply voltage for the data memory (RAM). Under normal conditions, the battery will therefore reach a life-time of approx. 10 years. For that reason, regular replacement of the backup battery is not required.

When data are lost by the data memory which might be caused by discharge of the battery, measure the battery voltage using a voltmeter with a high input impedance. The nominal open-circuit voltage of the battery is 3.6 VDC. The battery should be replaced whenever this voltage drops below 3.4 VDC.

Note:

If data are lost by the data memory due to a defective back-up battery either after a mains power failure or after a mains power switch-off, every single tuning sequence is to be performed individually which requires the full tuning time of up to 5 s.



ROHDE & SCHWARZ

Communications Division

**Appendix 1 to
User Manual**

**LINE FLATTENER
FK 859C1**

680.3013

Spare Parts Lists

STUECKLISTE		Benennung/Beschreibung			Z	Sachnummer		ÄI FP	DIN A	Blatt Nr.		
Für diese Unterlage behalten wir uns alle Rechte vor.		ERS-TEILL.F-TEILE FK859C1			Z	680.3020.01			02	1		
Stückliste					SA	Fertigungsplan			Fertigungs- Vorschrift	FH	Werk	K.-St.
Konstr. Abt./Name	ÄI	Änd. Mittlg.	Datum	Name	Aussteller	Anderung Datum	Name					
6KBH ST			1089	ST								
						Teile/Nutzen	Losgröße	Stückzahlbereich 1 bis Stück 2 bis Stück				
						Druckanforderung 601 3EPF						
						zugehöriges Verzeichnis		enthalten in Sachnummer				
FK859C1 LEITUNGSANPASSUNG						680.3013		000.0000				
VH	Lfd.-Nr.	Menge	ME	Kennzeichen	Benennung / Beschreibung	Z	KT	Sachnummer	Besch. Art. AK	Einbau- Code	FH	
Arbg. Nr.	Termin	WK-KST		Arb.-Pl.-Gr.	Arbeitsgang		B	Werkzeug-Nr.	tr	te		
	0003				VARIANTENERKL. / VERSIONS							
	10				VAR 02 = RAL 7035 LICHTGRAU							
	20				VAR 03 = RAL 6014 OLIV							
					VAR 04 = RAL 7001 MAR.GRAU							
	0010	0,01	S		ZM SPULENPLATTE	Z		680.3294.02	F9A			
	0020	0,01	S		ED KONDENSATORPLATTE	Z		680.3107.02	F9A			
	0030	0,01	S		ZM LUEFTERBLECH(LACKIERT)	Z		680.4232.02	F5A			
					VAR 02							
	0040	0,01	S		ZM LUEFTERBLECH(LACKIERT)	Z		680.4232.03	F5A			
					VAR 03							
	0050	0,01	S		ZM LUEFTERBLECH(LACKIERT)	Z		680.4232.04	F5A			
					VAR 04							
	0060	0,01	S		ZM RIEGEL LINKS	Z		718.0409.02	F5A			
	0070	0,01	S		ED ABSTIMMSTEUERUNG	Z		680.3507.02	F9A			
	0080	0,01	S		ED PROZESSORPLATTE	Z		680.3742.02	F9A			
	0090	0,01	S		LU TRAF0	Z		649.0716	F5A		W	
	0100	0,01	S		LD TRAF0	Z		649.0680	F5A		W	
	0110	0,01	S		LU TRAF0	Z		649.0722	F5A		W	
										ENDE		
Werk: München 10 ME: S = Stück M = m Teisnach 12 G = Gramm Q = m ² Memmingen 20 K = Kilogr. L = Liter												
											680.3020.01 ST BL 1-	



STUECKLISTE

Benennung / Beschreibung

Z
Z

Sachnummer

ÄI
FP

DIN
A

Blatt
Nr.

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ERS-TEILL.B-TEILE FK859C1

680.3036.01

0Z

1

Stückliste

SA

Fertigungsplan

Fertigungs-
Vorschrift

FH

Werk

K.-St.

Konstr. Abt./Name

Äl

Änd. Mittlg.

Datum

Name

Aussteller

Änderung
Datum

Name

6KBH ST

1089

ST

Teile/Nutzen

Losgröße

Stückzahlbereich

1 bis Stück **2** bis Stück

Druckanforderung **601**

3EPF

zugehöriges Verzeichnis

enthalten in Sachnummer

FK859C1 LEITUNGSANPASSUNG

680.3013

000.0000

VH	Lfd.-Nr.	Menge	ME	Kennzeichen	Benennung / Beschreibung	Z	KT	Sachnummer	Besch. Art. AK	Einbau-Code	FH
Arbg. Nr.	Termin	WK-KST		Arb.-Pl.-Gr.	Arbeitsgang		B	Werkzeug-Nr.	tr		te
	0003				VARIANTENERKL. / VERSIONS						
	10				VAR 02 = RAL 7035 LICHTGRAU						
	20				VAR 03 = RAL 6014 OLIV						
					VAR 04 = RAL 7001 MAR.GRAU						
	0010	0,01	S		LD 1,25UH+-5% 7WDG.RD60			680.3320	B1A		W
	0020	0,01	S		LD 2,5UH+-5% 10WDG.RD60			680.3336	B1A		W
	0030	0,01	S		EV 119X119X25 47L/S 24V-			586.9670	B1A		
									ENDE		

Werk: München 10
Teisnach 12
Memmingen 20

ME: S = Stück M = m
G = Gramm Q = m²
K = Kilogr. L = Liter

680.3036.01 ST BL 1-