APPLICATION NOTE

A broadband 3 W amplifier for band IV/V TV transposers based on the BLW898

AN98015

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Application Note AN98015

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1 ABSTRACT

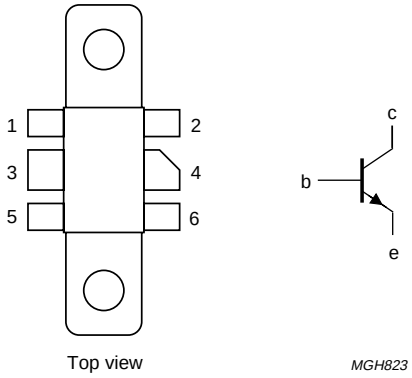
A broadband linear amplifier design is presented, suitable for application in TV transposers, operating in band IV and V (470 – 860) MHz. The design is based on a BLW898 bipolar transistor. Typical results at the recommended class-A bias point (25 V/1.1 A) for the total module include a 3-tone IMD level of –64 dB (fvision = –8 dB, fsideband = –16 dB and fsound = –10 dB) and an average gain of 10.5 dB at 3 W peak-sync output power in the (470 – 860) MHz frequency range.

2 INTRODUCTION

The BLW898 is a bipolar linear power transistor designed to operate in the (470 – 860) MHz range. The transistor is encapsulated in a SOT171A 6-lead rectangular flange package with a ceramic cap, see Fig.1.

The specified output power is 3 W peak-sync in class-A. The intermodulation distortion level (IMD) < –63 dB (fvision = –8 dB, fsideband = –16 dB and fsound = –10 dB) and gain >10 dB at 860 MHz.

For application in TV transposers for Band IV/V (470 – 860) MHz a wideband linear power amplifier has been designed operating in class-A. It is suitable for driving higher power stages in TV-transposers.



Pinning

PIN	DESCRIPTION
1	emitter
2	emitter
3	base
4	collector
5	emitter
6	emitter

Fig.1 Simplified outline and symbol.

3 AMPLIFIER ELECTRICAL DESIGN OBJECTIVES

Electrical characteristics (Ths = 25 °C; 25 V; 1.1 A; (470 – 860) MHz).

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Transducer power gain (small signal)	Gp	10	–	–	dB
Gain ripple (small signal)	Gripple	–	–	±1	dB
Intermodulation (–8 dB/–16 dB/–7 dB, Peak-sync = 3 W; note 1	IMD1	–	–	–60	dB
Intermodulation (–8 dB/–16 dB/–10 dB, Peak-sync = 3 W; note 1	IMD2	–	–	–63	dB
Output return loss	ORL	–	–15	–	dB

Note

1. Peak-sync is a reference power level for TV-signals, in this case used for a 3 carrier signal.

4 DESIGN OF THE AMPLIFIER

The amplifier consists of a BLW898 plus an input and output matching circuit. The input is gradually mismatched and therefore not matched to 50 Ω. To obtain a good input matching a balanced circuit with two BLW898 transistor is necessary. A schematic diagram of the BLW898 amplifier is given in Fig.2. A components list is given in “Appendix 1”.

4.1 Mounting the transistor

For good thermal contact, heatsink compound should be used when mounting the transistor on a heatsink.

4.2 Positioning of the matching capacitors (see Figs 3 and 4)

Input:

The capacitors C4 + C5 are situated as close as possible near the transistor

The capacitors C2 + C3 are situated on a distance of approx. 19 mm from the transistor

The position of the ‘input’ capacitors influence the tuning for flat gain.

Output:

The capacitors C6 + C7 are situated on a distance of approx. 10.5 mm from the transistor

The capacitors C8 + C9 are situated on a distance of approx. 21 mm from the transistor

Capacitor C11 is placed approx. 11.5 mm from stripline L3

The position of the ‘output’ capacitors is critical to obtain the S22 contours as described in the amplifier tuning procedure.

Note:

- RF choke L6 is placed approx. 5 mm from the transistor base.
- Stripline L5 is situated 2.8 mm from the transistor and 2.8 mm from L4.

5 AMPLIFIER TUNING PROCEDURE

The amplifier is tuned under small signal conditions by means of a networkanalyzer. The amplifier is tuned for flat gain over the complete bandwidth (470 – 860) MHz. To obtain a flat gain, the input is gradually mismatched. The input returnloss S11 is the main parameter for setting the gain level and flatness.

Tuning of the output will mainly influence IMD and to a lesser extent the gain flatness.

To obtain a good IMD performance over the band it is recommended to follow the S22 tuning contours as plotted in Figs 5, 6 and 7.

An S22 of about −15 dB is required over the complete bandwidth.

6 AMPLIFIER PERFORMANCE

Broadband measurement data is presented in Figs 8, 9 and 10.
Gain/IMD are measured versus frequency (470 – 860) MHz and versus peak-sync level (at ch69).
Gain/IMD are given at two 3-tone systems:

- fv = −8 dB/fsb = −16 db/fs = −10 dB
- fv = −8 dB/fsb = −16 db/fs = −7 dB.

Figure 3 gives gain compression (CW) versus frequency.

At a nominal peak-sync level of 3 W for which the module is dimensioned the performance in the (470-860) MHz band is as follows:

- 3-tone system: (−8/−16/−7) dB; IMD ≤61 dB/gain >10 dB
- 3-tone system: (−8/−16/−10) dB; IMD ≤64 dB/gain >10 dB.

(for both systems ripple ≤1.5 dB)

7 CONCLUSION

A broadband amplifier is presented based on a BLW898, capable of operating in full band IV/V with flat gain and good linearity. Design and tuning procedure described result in good broadband behaviour.

A typ. gain of 10.5 dB with good linearity (peak-sync = 3 W @ −64 dB (−8/−16/−10) dB 3-tone system) has been obtained at the class-A bias point (25 V/1.1 A).

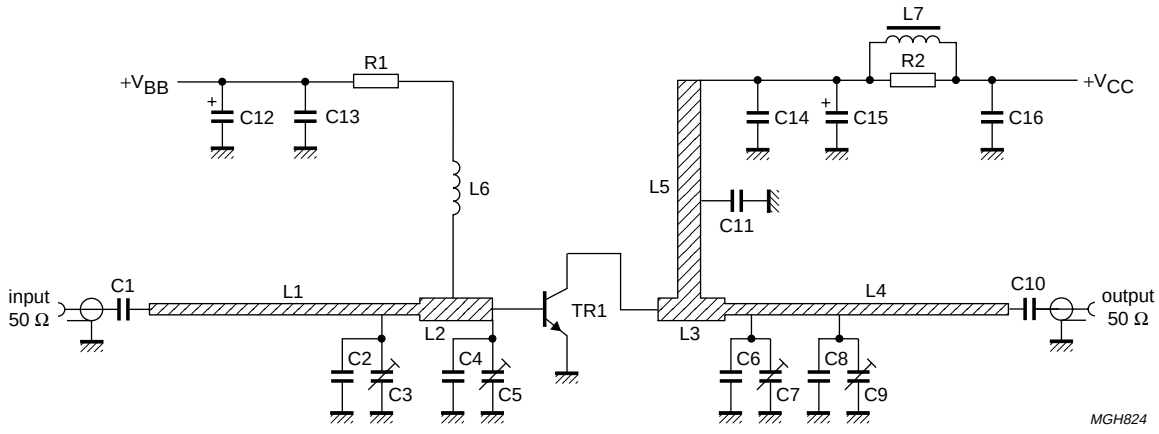


Fig.2 Schematic diagram of the BLW898 amplifier.

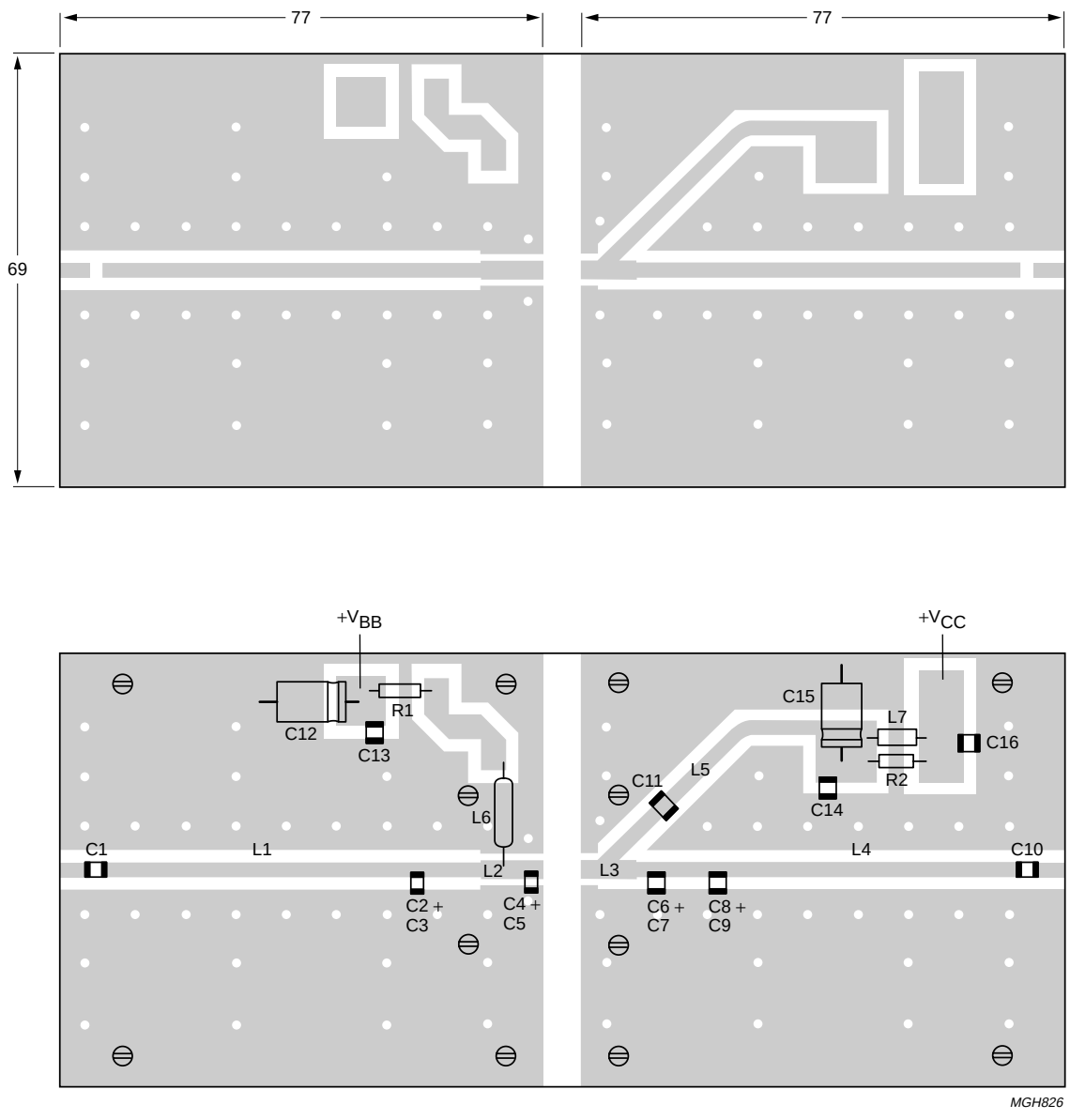


Fig.3 Component layout of the BLW898 amplifier.

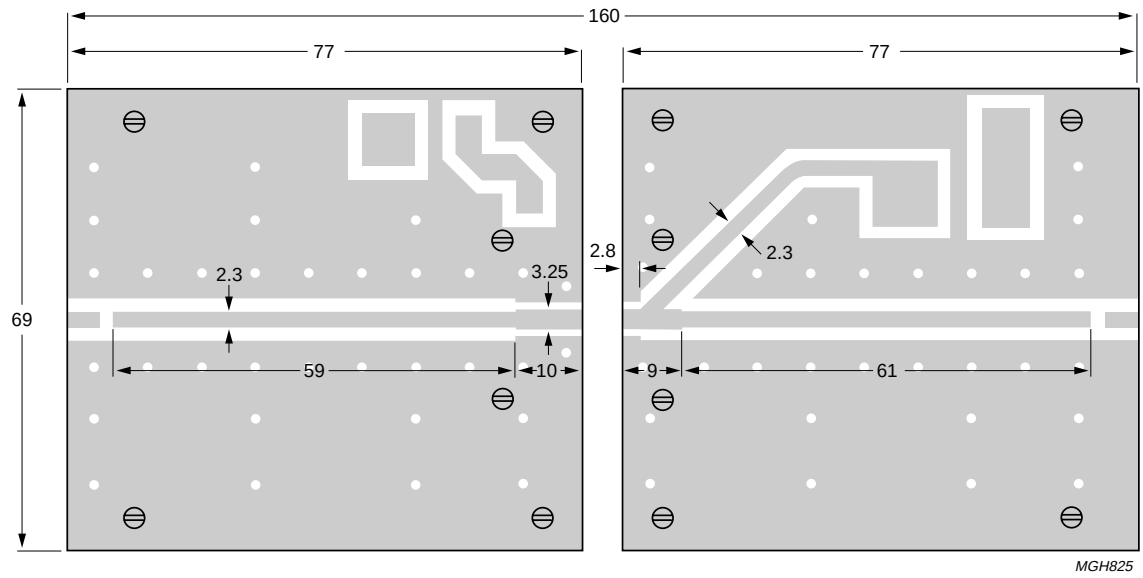
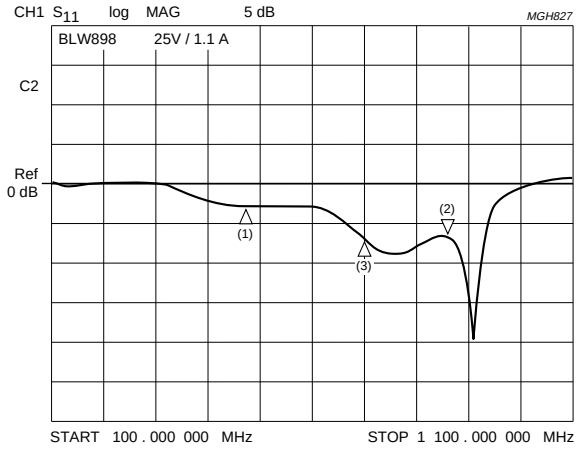
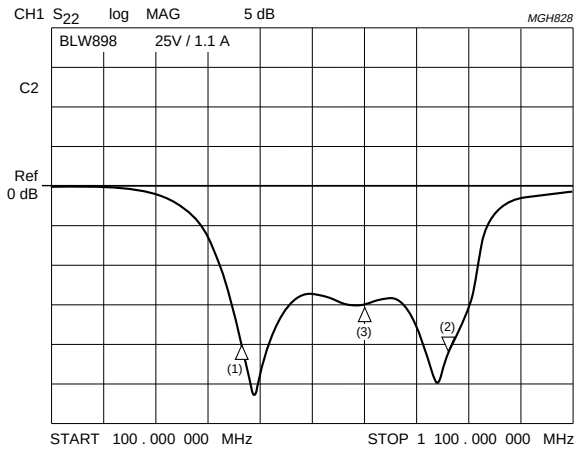


Fig.4 Dimensions of the BLW898 amplifier.



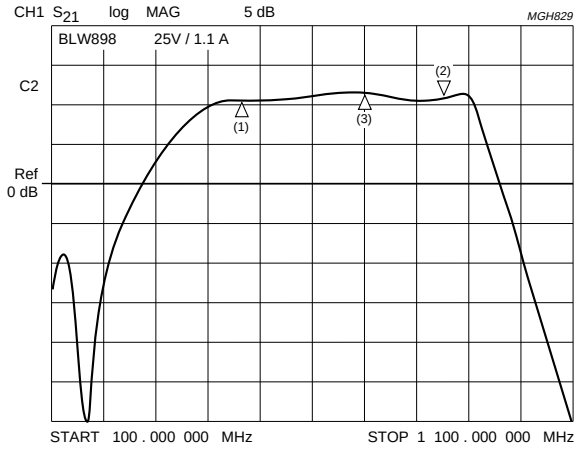
(1) 470 MHz; −3.0 dB.
(2) 600 MHz; −7.0 dB.
(3) 860 MHz; −7.0 dB.

Fig.5 Small signal results.



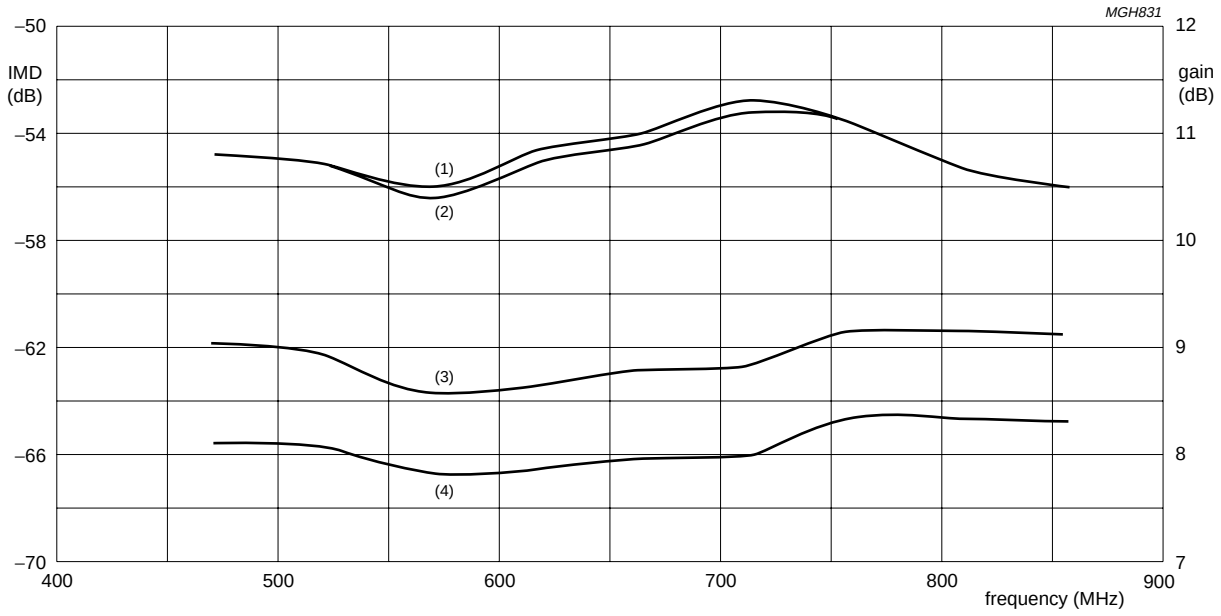
(1) 470 MHz; –20.8 dB.
(2) 600 MHz; –20.8 dB.
(3) 860 MHz; –15.0 dB.

Fig.6 Small signal results.

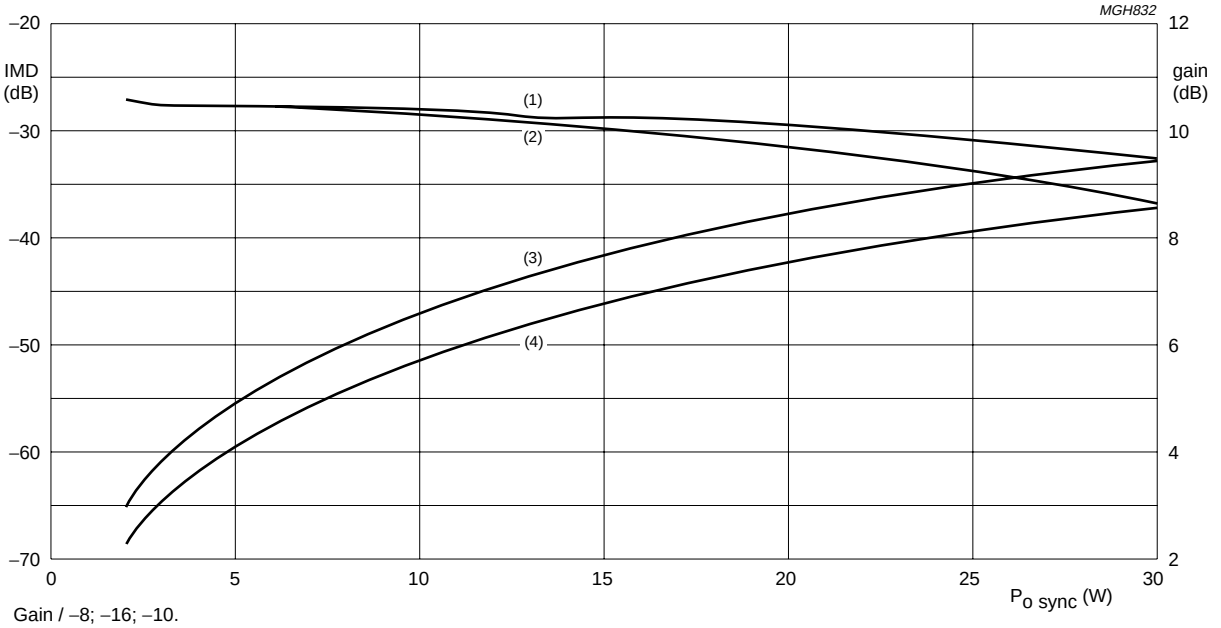


(1) 470 MHz; –10.5 dB.
(2) 600 MHz; –10.5 dB.
(3) 860 MHz; –11.3 dB.

Fig.7 Small signal results.

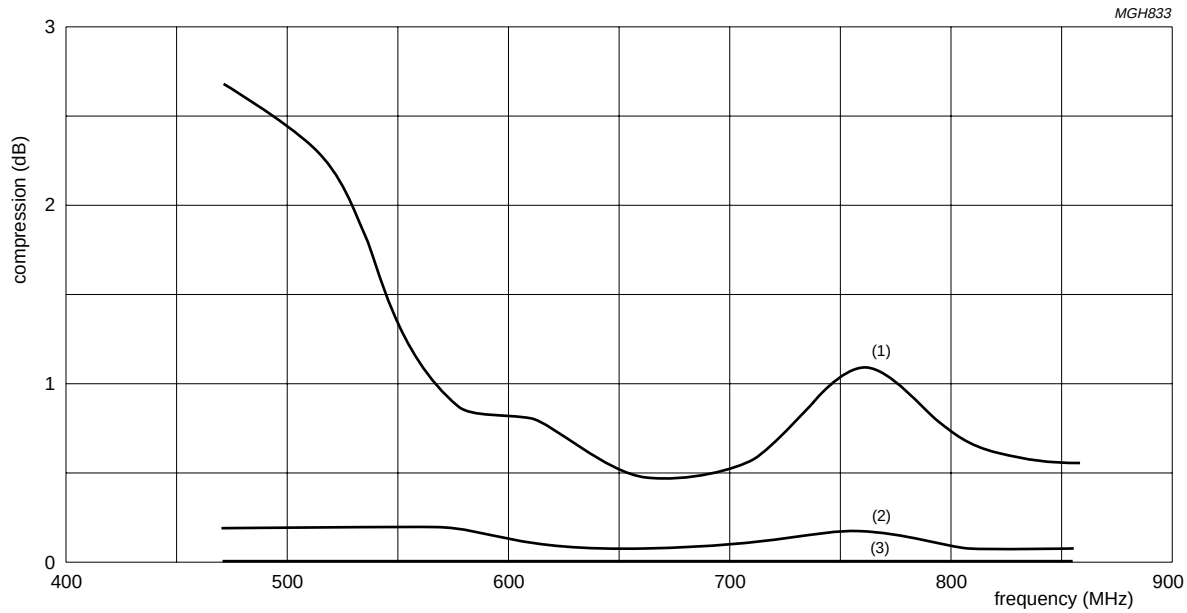


(1) Gain / –8; –16; –10.
(2) Gain / –8; –16; –7.
(3) IMD / –8; –16; –7.
(4) IMD / –8; –16; –10.



(1) Gain / –8; –16; –10.
(2) Gain / –8; –16; –7.
(3) IMD / –8; –16; –7.
(4) IMD / –8; –16; –10.

Fig.9 Demoboard BLW898; Gain/IMD vs Po_sync/Ths = 25 C; 25 V/1.1 A/ch69.



(1) PL = 1 W.
(2) PL = 5 W.
(3) PL = 10 W.

Fig.10 Demoboard BLW898; CW gain compression; 25 V/1.1 A/Ths = 25 C.

8 APPENDIX 1

Component list

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS
C1	multilayer ceramic chip capacitor, note 1	11 pF	
C2	multilayer ceramic chip capacitor, note 1	1.5 p	
C3, C5, C7, C9	Tekelec Giga trimmer 37271	0.6 – 4.5 pF	
C4	multilayer ceramic chip capacitor, note 1	15 p	
C6	multilayer ceramic chip capacitor, note 1	7.5 p	
C8	multilayer ceramic chip capacitor, note 1	2.7 p	
C10	multilayer ceramic chip capacitor, note 1	5.1 p	
C11	multilayer ceramic chip capacitor, note 1	270 p	
C12, C15	solid aluminium capacitor	47 μF; 63 V	
C13, C14, C16	multilayer ceramic chip capacitor	10 n	0805
L1	stripline, note 2	2.3 × 59 mm	50 Ω
L2	stripline, note 2	3.25 × 10 mm	40 Ω
L3	stripline, note 2	3.25 × 9 mm	40 Ω
L4	stripline, note 2	2.3 × 61 mm	50 Ω
L5	stripline, note 2	2.3 × 41.5 mm	50 Ω
L6	RF choke	220 nH	
L7	grade 4S2 ferrocube wideband RF choke (12NC: 4330 030 36301)		
R1	metal film resistor	10 Ω; 0.6 W	
R2	metal film resistor	50 Ω; 0.6 W	

Notes

1. ATC capacitor type 100B or capacitor of same quality.
2. PCB manufacturer: Rogers Ultralam 2000 (BO300M1046QB) (ε_r = 2.55, thickness 0.76 mm), (stripline value: width × length).

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