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**Radiocommunications Assignment and Licensing Instruction**

**MANAGEMENT OF BI-DIRECTIONAL  
AMPLIFIERS IN THE LAND MOBILE  
SERVICE IN THE FREQUENCY  
RANGE 29.7 MHz TO 520 MHz**

**WARNING: THIS RALI IS UNDER REVIEW. IF YOU HAVE ANY CONCERNS ABOUT THE CURRENCY OF PARTICULAR SECTIONS IN THIS RALI, PLEASE CONTACT GILLIAN KEMPTON BY TELEPHONE (02) 6256 5429 OR BY E-MAIL GKempton@aca.gov.au.**

**NOTE: All references to the Spectrum Management Agency, should be read as references to the Australian Communications Authority. Similarly, all references to the SMA should be read as references to the ACA.**

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***SPECTRUM MANAGEMENT AGENCY***

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# **RADIOCOMMUNICATIONS ASSIGNMENT AND LICENSING INSTRUCTIONS**

## **DISCLAIMER**

The Australian Communications Authority (ACA) advises that these instructions reflect the current policies of the ACA.

Prospective applicants for licences should, however, on their own responsibility, take whatever steps necessary to ensure that they have access to appropriate technical or other specialist advice independently of the ACA concerning their applications, the operation of radiocommunications equipment and services, or any other matters relevant to the operation of transmitters and services under the licences in question.

The policies of the ACA, and the laws of the Commonwealth, may change from time to time, and prospective licensees should ensure that they have informed themselves of the current policies of the ACA and of any relevant legislation. Furthermore, prospective applicants for licences should not rely on statements made in these instructions about the policies that may be followed by other authorities, nor about the effect of legislation.

Radiocommunications Assignment and Licensing Instructions are subject to periodic review and are amended as necessary. To keep abreast of developments, it is important that users ensure that they are in possession of the latest edition.

No liability is or will be accepted by the Minister for Communications, the Information Economy and the Arts, the ACA, the Commonwealth of Australia, or its officers, servants or agents for any loss suffered, whether arising directly or indirectly, due to reliance on the accuracy or contents of these instructions.

Suggestions for improvements to Radiocommunications Assignment and Licensing Instructions may be addressed to the ACA at PO Box 78, Belconnen, ACT, 2616. It would be appreciated if notification to the ACA of any inaccuracy or ambiguity found, be made without delay in order that the matter may be investigated and appropriate action taken.

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# Management of Bi-directional Amplifiers in the Land Mobile Service in the Frequency Range 29.7 MHz to 520 MHz

## 1.0 Introduction

Bi-directional Amplifiers (BDAs) receive incoming radio frequency (RF) signals within particular frequency bands, for example base transmit and mobile transmit (ie, base receive) frequency segments in a land mobile system, then amplify and re-transmit them on the same frequencies. These devices are typically used in conjunction with leaky feeder (LF) cables to provide radio coverage in enclosed areas; such BDA/LF systems may be stand alone (eg used in an underground mine) or may be used to provide 'fill-in' coverage in shielded locations within the wider service area of a 'parent' land mobile system.

Leaky feeder cables include bi-filar lines, continuously leaky coaxial cables, coaxial cables with periodic apertures and cables with mode converters or radiating elements (eg 'discrete' antennas) [Ref 1].

## 1.1 Purpose

The purpose of this RALI is to provide information about the management of BDAs in the land mobile service in the frequency range 29.7 MHz to 520 MHz.

This RALI applies to BDAs linked via single channel transceivers to land mobile systems operating in the frequency range 29.7 to 520 MHz, in order to provide 'fill-in' coverage; configuration details are further described in section 2.0. Instructions for other configurations may also need to be developed in the future.

The information in this document reflects the Spectrum Management Agency's statement of policy in relation to the management of bi-directional amplifiers in the land mobile service in the frequency range 29.7 MHz to 520 MHz. In making decisions, Spectrum Management Agency (SMA) officers should take all relevant factors into account and decide each case on its merits. If an issue related to this document appears to fall outside the enunciated policy, please consult the Manager, Compliance and Licensing Directions Team, Central Office.

## 2.0 Typical Configuration

Given the broadband nature of BDAs, it is necessary to consider the potential for interference. The main interference mechanism relates to the retransmission of unwanted signals appearing at the input to the BDA. The objective is to impose the least technical restrictions on BDAs such that interference to other services is managed. This essentially means relying on:

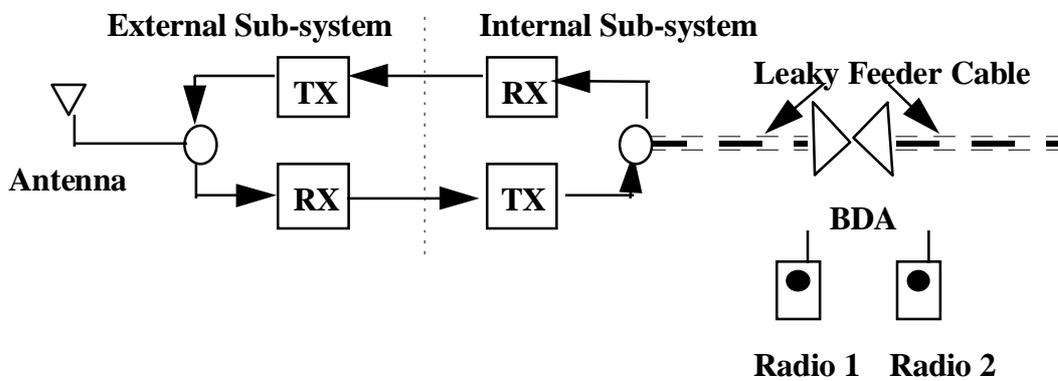
- (a) natural isolation from the outside RF environment; or
- (b) adding components to achieve that isolation.

## 2.1 Externally Linked BDA/LF Systems

In the configuration shown in Figure 1, there is an external sub-system that links back to a land station in a land mobile system. It is necessary to minimise the emissions that are coupled to the environment external to the enclosure. This is achieved by only allowing the use of narrowband (ie single channel) transceivers to interface the BDA/LF system to the external environment (as depicted in Figure 1); and by limiting the power that may be coupled into the leaky feeder cable.

Systems such as those depicted in Figure 1 may use BDAs as ‘power boosters’ along the length of the leaky feeder to maintain RF signal level, provided such amplifiers are not connected to an antenna that radiates externally to the enclosure. As noted above at section 1.0, discrete antennas are permitted within the enclosure as elements of the leaky feeder cable.

**Figure 1 - Typical Configuration of a BDA/LF System with an External Link**



## 3.0 Technical Requirements

### 3.1 BDA/LF Systems Linked with an External Land Station

#### 3.1.1 General

The following general technical requirement applies to a BDA/LF system linked with an external land station:

- The system must be located within 40 km of the associated ‘parent’ land station.

### 3.1.2 Internal Sub-system

The environment associated with the internal sub-system (refer Figure 1) will typically provide a high degree of shielding with respect to emissions passing beyond the enclosure. Nevertheless, the potential for emissions escaping beyond the enclosure and causing interference to geographically adjacent co-channel mobile receivers is a consideration. The following technical condition must therefore be included on any licence issued for a land mobile system that includes a BDA/LF system linked with an external land station:

- The power coupled into the leaky feeder cable from any BDA or associated transmitter in the system must not exceed 1 W.<sup>1,2</sup>

### 3.1.3 External Sub-system

The external sub-system has interference characteristics similar to a land station used for remote control purposes in the land mobile service, provided the following technical conditions<sup>3</sup> are met; sub-systems operating in accordance with these conditions do not require individual frequency coordination:

- The output power of the transmitter associated with the BDA and providing the link with the external land station must not exceed 1 W;
- The external radiating antenna may be located at any height above ground level in order to achieve reasonable service reliability, except within central business districts, where the height of the antenna should not exceed 30 metres above ground level;
- The external radiating antenna must be directional, with minimum gain equivalent to a 6 element Yagi; and
- Within central business districts, a 20 dB in-line attenuator must be fitted between the transmitter and the external antenna.

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<sup>1</sup> This power limit (1 W) may typically result in signal levels of -110 dBm at adjacent channel mobile receivers in the same enclosure (see following footnote for rationale). This is below the planning limit for interference management purposes. However, as it is slightly above the minimum usable sensitivity of typical land mobile receivers (dependent on actual environmental noise levels), some nuisance interference might occur. Other practical factors, such as the likelihood of adjacent channel receivers sharing an enclosure and the duration for which such a situation could be expected to occur (eg the time for which a vehicle is in a tunnel), diminish the likelihood of nuisance interference actually occurring.

<sup>2</sup> A typical coupling loss of 75 dB can be expected between a leaky feeder cable and any nearby receiver [Ref 1]; and a minimum adjacent channel selectivity of 65 dB can be expected in a typical land mobile receiver [Ref 2]. For a radiated power of 1 W (30 dBm), this would result in an unwanted signal received at a mobile of approximately -110 dBm.

<sup>3</sup> It should be noted that these conditions are derived from the regulatory framework for land stations used for remote control purposes.

## 4.0 Licensing Requirements

### 4.1 General

Operation of a BDA/LF system that meets the technical conditions specified in this RALI is authorised under the licence for the land mobile system of which it is a part. There is thus no need to individually licence such a BDA/LF system, and no licence fees are payable in respect of such a system.

LMS licensees are required to advise of the location of BDA/LF systems operating under their licences. The relevant spectrum access records in RADCOM should then be identified with an appropriate comment (eg 'BDA/LF system located at .....'), in the 'Assigner's Remarks' field of the database. This will assist with future identification and management of these systems.

### 4.2 Licensing Requirements for a BDA/LF System Linked with an External Land Station

The following licensing requirements apply to a BDA/LF system linked with an external land station:

- TLS 18/1995 - Land Mobile (Land Mobile System) must be applied to the Land Mobile System licence of which the BDA/LF system is a part. This TLS applies the technical conditions specified at section 3.0 to any BDA/LF system operating under that licence; and
- Special Condition LT should be applied to the relevant Land Mobile system licence. This condition reads as follows:

'Whilst every effort will be made by the SMA to investigate reports of interference to any BDA system authorised for operation under this licence, no guarantees can be made that such interference will be reduced or eliminated. Additionally, should interference to another licensed radiocommunications service be reported and the SMA considers that such interference arises from a BDA system operating under this licence, the licensee may be required to modify, or cease, operation of that BDA system.'

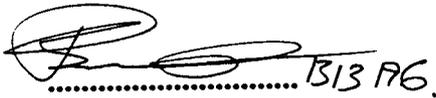
## 5.0 Compliance Requirements

There are currently no equipment compliance requirements for BDAs operating under the conditions described in this RALI. It should be noted, however, that transmitters and receivers operating as part of BDA/LF systems (other than BDAs themselves) are required to comply with the SMA's Radiocommunications Standard for Analogue Speech (Angle Modulated) Equipment [Ref 2].

## 6.0 References

- [1] ITU-R Recommendation M.1075 "General Aspects of Leaky Feeder Systems in the Land Mobile Service" (supersedes CCIR Report No 902-1, 1990).
- [2] Radiocommunications Standard (Analogue Speech (Angle Modulated Equipment)) No. 1 of 1995 - Statutory Rules 1995 No. 428.

## RALI Authorisation

A handwritten signature in black ink, appearing to read 'R. Smith', with a dotted line underneath it. To the right of the signature, the date '13/3/96' is written.

**Roger Smith**  
**Executive Manager**  
**Business Directions Group**  
**CANBERRA**