Application Note 400
DS2155 Monitor Mode Design

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INTRODUCTION

Monitor mode is used in applications in which an active T1/E1 line is tapped by a secondary receive circuit to monitor the data flow. In monitor mode, a pair of resistors are used to split the signal from the main T1/E1 line to the monitor path. While there is a slight drop in the signal level of the main T1/E1 line, the monitor path can be orders of magnitude lower than the original signal. There are two ways to compensate for the loss in the monitor path and bring the signal back to a level where the receiver can properly decode the data. The transformer winding and termination resistance can be altered to provide an additional signal boost into the front end of the receiver, or the receiver can integrate an active linear (flat) gain amplifier to provide an additional signal boost. To simplify the external receive circuit design, the DS2155 was created with integrated linear-gain amplifiers.

RECOMMENDED MONITOR MODE CIRCUIT

Figure 1 is Dallas Semiconductor's recommended circuit for T1/E1/J1 monitor mode applications. The DS2155 can provide linear gain of either 0dB (default), 20dB, 26dB, or 32dB. The gain choice is determined by the MM0 and MM1 bits in the LIC3 register of the DS2155. Table 1 provides the specific gain settings for the DS2155.

Table 1. Monitor Mode Register Settings for LIC3

MM0 (LIC3.3)	MM1 (LIC3.4)	INTERNAL LINEAR GAIN BOOST (dB)
0	0	0 (normal operation)
0	1	20
1	0	26
1	1	32

When a new system with monitor mode is being designed, it is necessary to compute the values for the tap resistors based on the desired linear gain setting. Likewise, if only the value of the tap resistors is known, it is necessary to compute the linear gain setting. The following equation allows for easy computation of the linear gain based on the values of tap resistors (Rm) and the termination resistors (Rt). Note: The results of the linear gain are in negative dB to indicate that the signal has been attenuated.

$$\text{Linear Gain (dB)} = 20 \log (V_{OUT} / V_{IN})$$

$$V_{IN} = i \times (2Rm + 2Rt) \text{ and } V_{OUT} = i \times 2Rt$$

$$V_{OUT} / V_{IN} = 2Rt / (2Rm + 2Rt)$$

$$\text{Linear Gain (dB)} = 20 \log [2Rt / (2Rm + 2Rt)]$$

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This equation is similar to the previous one, but allows for the easy computation of the tap resistors (Rm) based on the linear gain and the termination resistors (Rt). Note: When the linear gain value is expressed without the dB marking, the value is simply a numeric ratio.

$$\text{Linear Gain (dB)} = 20 \log [2R_t / (2Rm + 2Rt)]$$

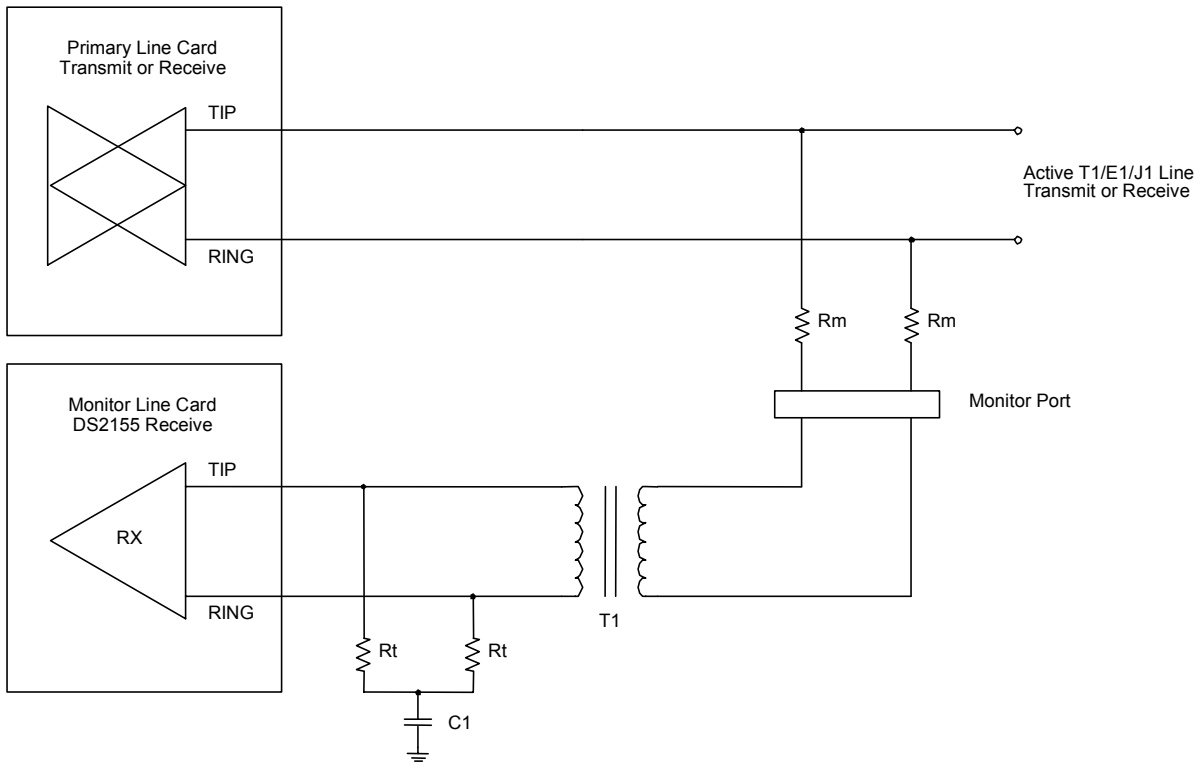
$$\text{Linear Gain} = 2Rt / (2Rm + 2Rt)$$

$$2Rm + 2Rt = 2Rt / \text{Linear Gain}$$

$$Rm = (Rt / \text{Linear Gain}) - Rt$$

When computing the values for linear gain, tap resistor, or termination resistor values it may not be possible to match these values with standard components or settings. In these cases, holding the linear gain values to within ±2dB or choosing the closest standard value for the resistors should work fine.

Figure 1. Recommended Monitor Mode Circuit for DS2155



NOTE: THE LAYOUT FROM THE TRANSFORMERS TO THE NETWORK INTERFACE IS CRITICAL. TRACES SHOULD BE AT LEAST 25MILS WIDE AND SEPARATED FROM OTHER CIRCUIT LINES BY AT LEAST 150MILS.

The components used for monitor mode in the DS2155 are exactly the same for the normal mode of operation. The transformer winding is 1:1 and the termination value remains the same (i.e., 100Ω for a T1 line and 120Ω or 75Ω for an E1 line). Also, the software-selected receive termination can still be used in monitor mode applications if the termination resistors (Rt) are set to a value of 60Ω for a default termination value of 120Ω. The components listed in Table 2 were chosen for circuits in which the DS2155 would operate in the 20dB monitor mode and the internal software selected termination is enabled. This allows the circuit to be used with T1 and E1 lines with a termination of 100Ω or 120Ω. For operation of a 75Ω E1 line, the values for the tap resistors have to be adjusted.

Table 2. Recommended Components

COMPONENT	DESCRIPTION	SUPPLIER	NOTES
C1	0.1µF, 5% Tol, 10 V	—	
Rt	60Ω, 1% Tol, 1/8 W	—	60Ω for software-selected termination
Rm	470Ω, 1% Tol, 1/8 W	—	470Ω for 20dB monitor mode setting
T1	Transformer 1:1	Pulse Engineering	
		Halo Electronics	

SUPPLIERS LIST

SUPPLIER	PHONE	FAX	WEBSITE
Pulse Engineering, Inc.	(858) 674 - 8100	(858) 674 - 8262	www.pulseeng.com
Halo Electonics, Inc.	(650) 903 - 3800	(650) 903 - 9300	www.haloeletronics.com