

## Optimizing Transmission Levels with the 73M2901CE

The Teridian 73M2901CE single chip integrated circuit modem provides all the microprocessor control and modulation and demodulation functions required to implement a V.22 *bis* 2400 bps modem. Equipment intended to be connected to the Public Switched Telephone Network (PSTN) must comply with specific standards such as FCC part 68, CTR-21, JATE, etc. A certification process usually verifies conformity to those standards.

Among the regulatory requirements, there are both maximum and minimum levels at which the modem may transmit. The normal default transmission levels for data and DTMF tones as measured on the line may be lower than desired when using the 3.3V 73M2901CE. Additional losses through the DAA could reduce the levels even further. The following information is provided to aid you in properly setting up the 73M2901CE to achieve the optimal transmit levels.

### Data Transmission Level Adjustment

The requirements on the data level only specifies a high limit, usually -9 dBm, above which no carrier signal may be transmitted on the PSTN line. Using the 73S2910CE default settings, data carrier transmission will typically have output well below the maximum transmit levels. It is generally preferable to transmit as high as permitted without exceeding the maximum level since this insures the best reception by the receiving modem, and therefore potentially fewer data errors.

The 73M2901CE allows access to data carrier level control through the S register S13, DTMF/Data Transmit attenuation. By modifying the low nibble of this register the user is allowed to add up to 4dB gain to the data level with a 2dB gain increment.

ATS13=16 (default) → ATS13+2 (2dB over nominal default value)

### DTMF Level Adjustment

The requirements on the DTMF levels are the harder to achieve since all standards specify a high and low limit defining a window within which the DTMF tones must be transmitted. It has to be noted that the DTMF signal is a combination of two tones, with an amplitude difference of typically 2dB. This discussion will only focus on the higher frequency tone, since it is the most difficult to address, and the lower frequency tone level will follow as long as the higher level tone is correct.

The typical level limits are as follows:

Condition 1:

High tone	-6dBm ± 2dB	/ -8dBm to -4dBm /
Low tone	-8dBm ± 2dB	/ -10dBm to -6dBm /

Condition 2:

High tone	-9dBm ± 2dB	/ -11dBm to -7dBm /
Low tone	-11dBm ± 2dB	/ -13dBm to -9dBm /

Condition 3:

<i>CTR-21</i>		
High tone	-9dBV +2/-2.5dB	/ -9.29dBm to -4.79dBm /
Low tone	-11dBV +2/-2.5dB	/ -11.29dBm to -6.79dBm /

The most difficult requirement appears to be the condition 1 where the high tone level has to be between -8dBm and -4dBm.

The 73M2901CE provides a way to raise the DTMF levels through the high nibble of the S13 register, allowing an additional 2dB increase to the nominal default value.

ATS13=16      →      ATS13=32

Depending on the transmit losses of the DAA, the added gain may still not be enough to reach the -8dBm lower limit. The 73M2901CE provides an additional means to raise the DTMF levels through modification of the transmit DAC coefficient. This coefficient is controlled by the S register S85 which defaults to 60 and has a range up to 127. Although it is easy to increase the DTMF value through that register, caution has to be taken since raising the value of that register also increases signal distortion and therefore the noise which is specified by the many standards.

The following levels have been measured using a discrete line interface:

Configuration string:    ATS13=32S85=75J1

Levels measured:	high tone	-7.21dBm
	Low tone	-9.04dBm

These levels satisfy the most requirements for DTMF tone transmit levels while having an acceptable signal distortion.

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