Test Memo # 155

6/15/90

ALC Testing Report

This report is a summary of the ALC testing and analysis of the backend ALC loop contained within the T5 module. Testing of the loop time response was done by connecting a chart recorder to the detector output on the T5 module. The input power level was varied by adjusting the receive gain pot on the T2 module. The assumptions were that the pot could be turned fast enough and each pot on each T5 would vary the power the same amount for a given pot rotation. The power step provided was about 2 dB or a one quarter rotation of the pot. The chart recorder response for the loops was a typical exponential decay function. Almost all of the T5s were measured and the response times varied from .5 sec to 3.6 sec with an average of about 1.5 sec. The wide range of the response was very disturbing and unexpected. A simplified analysis was performed using the approach described by Porter (1). The results of the analysis are as follows:

The loop error as a function of time is

e(t)=exp(-KVt)

where KV=(KD)(KC)(KL)(A1)

for a simple integrator

A1 is intergrator gain which equals 1/(R*C)

R=150K C=10uF

therefore A1=.67

KC is a conversion factor = .115 nepers/dB

KD is a detector constant which for a square law detector

KD=2ED

for a linear detector

KD=ED+Ed

Where ED is the voltage out of the detector =5 volts

and Ed is the diode voltage drop

KL is the control voltage sensitivity in dB/volt

this is the slope of the AGC amp around the required operating point. For our AGC amp this is very nonlinear and difficult to define.

One T5 was was measured in the lab. The internal switch was turned on so that we were working with our square law detector. The input power was varied in one dB steps from -24 dBm to -34 dBm and the ALC voltage was measured. This curve is shown in Figure 1. As one can see the higher the input power the steeper the slope and the more sensitivity. Taking an average slope around the normal operating point of -28.5 dBm we obtain KL = 4.16 dB/volt. Next if we swing 3 dB on either side of our normal operating point then KL=2.5 dB/volt or KL=6.9 dB/volt. Taking these values and calculating the reponse we arrive at Figure 2. As one can see the time varies about 1 sec. I assume that the variation will be wider because the AGC amplifier characteristics will also vary.

One final experiment was performed at the D rack. I decided to look more closly at antennas 4 and 12. More specifically at 4B and 12C. The time reponse orginally measured on 4B was 3.6 sec and on 12C was .6 sec. These two channels have the newer square law detector in the sampler. I first remeasured both channels and repeated my previous data. Then I swapped T5s between the channels and remeasured. 4B measured close to 3 sec and 12C was around .5 sec. I then removed the T5s and switched the one that was in 12C to the internal square law detector and put it back in 4B. 4B still measured around 3 sec. This T5 was then placed in 12C and the measurement was again around .5 sec. This proved that ALC response was some what T5 and detector independant and was antenna dependant. The power coming to the T5s was measured. 4B measured -28 dBm and 12C measured -21 dBm. the spec is -28.5 +/- 5 dB. The incoming IFs were measured and 12C was 5 dB higher than the other IFs. This higher power causes the AGC amp to be more in the steeper slope region and have a higher sensitivity and therefore a faster ALC reponse time. I believe that the majority of the ALC response time variation is due to IF power and AGC amp variations. The only solutions I can think of would be to tighten the specs on both the power levels and the device characteristics or to add a amplifier/attenuator on the input of the T5 to put the T5 into a more desiriable operating range for the AGC amp.

1. Porter, Jack; "AGC Loop Design Using Control System Theory", R.F. Design, June 1980

Regards

Terry Cotter

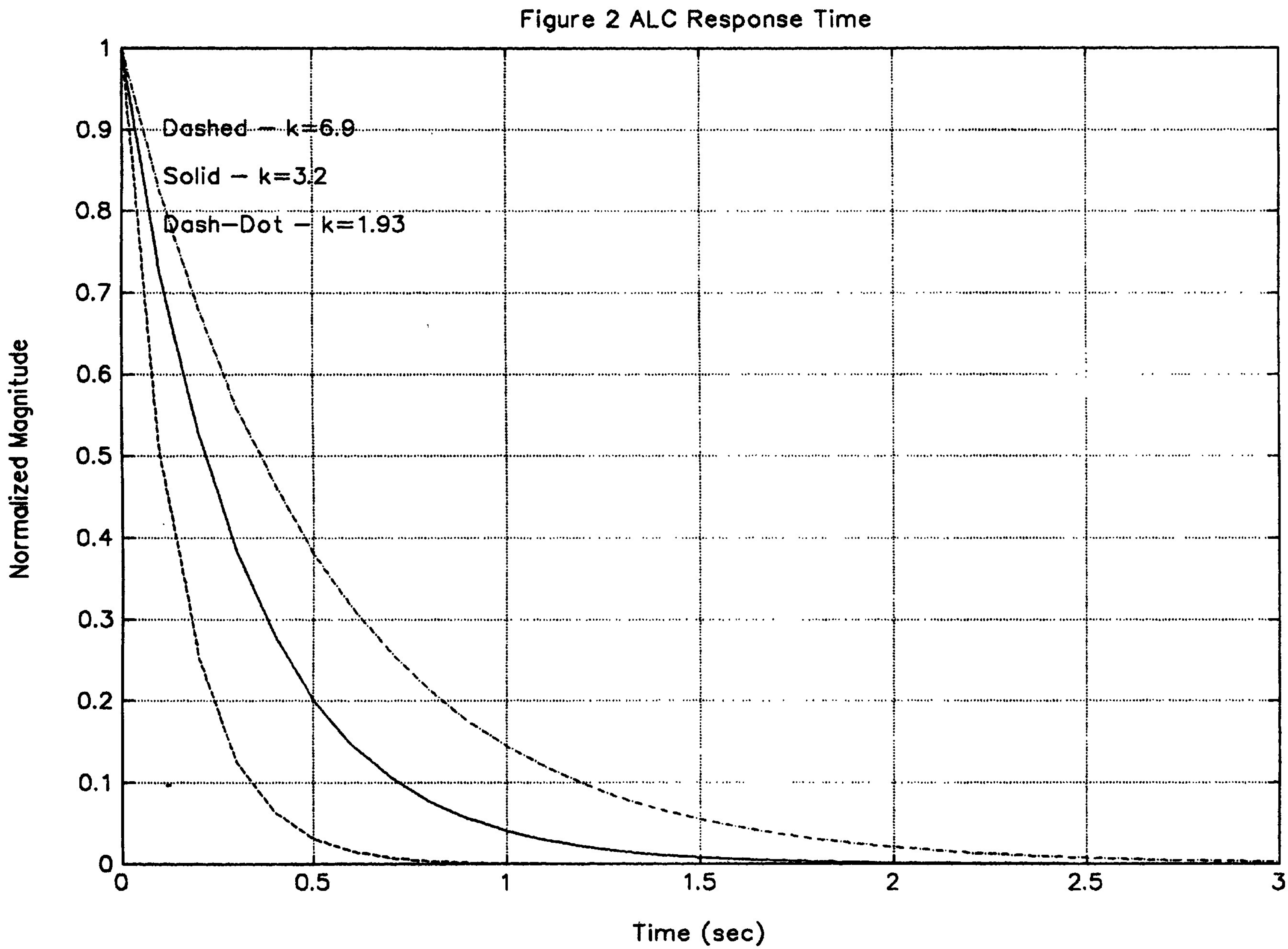
Figure 2 ALC Response Time
Normalized Magnitude
Time (sec)
Dashed – k=6.9
Solid – k=3.2
Dash–Dot – k=1.93
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.5
1
1.5
2
2.5
3

Figure 1 ALC Voltage