Attention: George Paclik

On 01/30/2010 post installation EMI testing was conducted in accordance with Appendix B of Technisonic's TDFM-136 Installation and Operating Instructions TIL Document No. 99RE255, Rev. D Issue 7, dated April 2004. As a result of those tests it was determined that an interference problem exists as pertaining to the operation of the aircraft glideslope system while being ramp checked. This interference occurs in the form of the glideslope flagging a loss of signal and/or glideslope needle deflections.

Three different aircraft and seven different TDFM-136 transceivers were ramp tested and it was determined that the problem is prevalent in all TDFM-136 transceivers tested.

## Ramp Test Procedure

1. **C-23A Sherpa:** While ramp testing with an IFR 4000 that was set to an ILS frequency of 108.10/334.70 Mhz with a minimum output to stabilize the ILS needle and pull the glideslope flag it was determined that the #2 TDFM-136 with a frequency of 167.350 Mhz when transmitting would cause immediate flagging of the both GNS-430's glideslope. It would take an additional 20dbm of the IFR 4000 test signal to finally overcome the TDFM-136 2$^{nd}$ harmonic interference that was being transmitted at 334.70 Mhz.. The TDFM-136 and the glideslope antenna are 26 feet part and are in line of sight of each other on top of the aircraft. When transmitting on the #1 TDFM-136, whose antenna is located 10 feet below the glideslope antenna on the belly of the aircraft, it would take approximately 20 seconds and then the glideslope would flag.
2. **Cessna TU206G:** While ramp testing under the same conditions as Step 1 the same interference was observed. It would take an additional 25dbm of the IFR 4000 test signal to finally overcome the TDFM-136 2$^{nd}$ harmonic interference that was being transmitted at 334.70 Mhz.. The TDFM-136 and the glideslope antenna are 16 feet part and are in line of sight of each other on top of the aircraft.

## Bench Test Procedure

The following equipment was used and bench testing was accomplished to determine the following test results:

1. **Test Equipment**
    a. IFR FM/AM 1200S Communications Monitor
    b. BK Precision 1743 Power Supply
    c. Telewave 44A Wattmeter
    d. Bird 8085 50 Ohm Coaxial Resistor
    e. Comant CI-177 VHF FM Antenna
    f. 2 ea - 6 foot RG223 Coaxial Cables
2. **Transceiver Test Parameters**
    a. UUT - TDFM-136 S/N# FD3242
    b. Band – WIDE
    c. Power - HI

## 3. Test Results

a. While transmitting on 167.350 Mhz the transmit power from the UUT was 8.5 watts as determined by the1200S and 44A. Reflected power was determined to be near zero (negligible) by the 44A wattmeter.
b. While monitoring on 167.350 Mhz in a direct connection to the 1200S - a significant 2nd harmonic signal at 334.700 Mhz and a lesser 3rd harmonic at 502.050 Mhz were observed. These results coincide with the findings in the aircraft.
c. The following test results where observed while using the 1200S antenna connection to monitor the UUT output through a CI-177 antenna on 167.350 Mhz:
d. 167.350 Mhz – relative signal strength - 91
e. 334.700 Mhz – relative signal strength - 24
f. 502.050 Mhz – relative signal strength - 12
g. The 2nd and 3rd harmonics are 41% and 13% respectively in strength to the fundamental test frequency.
h. The 2nd harmonic tracks across the range of the UUT and does lose strength at the lower glideslope frequency of 329.15 Mhz with a relative signal strength of 24 which is still 26% of the fundamental 164.575 Mhz signal strength of 91.
i. George Paclik – President of Technisonic and RF Engineer indicated that TDFM-136's are factory tested for 2nd harmonics at the following frequencies – 138, 156 and 174 Mhz. In checking these frequencies we found that the 2nd harmonic is 11% in strength to the fundamental test frequency with the exception of 156 Mhz where the 2nd harmonic is 23% in relative strength to the fundamental test frequency. As the TDFM-136 is moved through 164.575 to 167.500 Mhz does the 2nd harmonic increase in strength which coincides with glideslope frequencies 329.15 through 335.00 Mhz.
j. As a final test, a dummy load was attached to the UUT. While monitoring the 1200S and the UUT transmitting it was observed that a significant amount of the fundamental test frequency and the 2nd harmonic was being radiated from the UUT. As the 1200S was located within 2 feet of the UUT it was found that this could skew the relative signal strength data collected above. We relocated the 1200S 45 feet away and rechecked the UUT and noted that significant RF case leakage was still present.

## Flight Test Procedure

1. **C-23A Sherpa:** On 02/09/10, a flight test was conducted utilizing the Redmond, Oregon ILS which transmits on 109.10/331.40 Mhz. A corresponding frequency of 165.700 Mhz, which would result in a 2nd harmonic of 331.40 Mhz, was entered into the #2 TDFM-136. The aircraft was flown to a distance of 43 miles from the approach end of Rwy 22 as measured with the GPS at an altitude of 12,000 feet. The glideslope vertical needle indication had a full up deflection and the flag was out of view with no signs of instability. The #2 TDFM-136 was repeatedly keyed while tracking inbound to the Redmond airport with no adverse effect on either GNS-430 Glideslope. The aircraft was not flown to maximum reception distance, which would have simulated ramp test conditions, as practically speaking a glideslope is rarely flown from 43nm out from the airport.

## Conclusion

1. Mr. Paclik has indicated that the harmonic levels that are been seen during the tests conducted above are impossible to achieve. While lacking certification quality test equipment like the manufacturer it has been shown for a fact that the TDFM-136 causes glideslope interference and failure in multiple aircraft being ramp tested.
2. The information that has been gathered from Mr. Paclik is that the factory test frequencies of 138, 156 and 174 Mhz is where harmonic attenuation level testing is accomplished. These frequencies do not generate a 2$^{nd}$ harmonic within the glideslope frequency range and the frequencies of 164.575 through 167.500 which would generate a 2$^{nd}$ harmonic within the glideslope frequency range are not being checked as a part of final certification testing. Our testing shows significant 2$^{nd}$ harmonics within the 164.575 through 167.500 Mhz range which are of a sufficient enough level as to interfere with reception of the glideslope signal.
3. While the flight test at 43nm showed no problems - ramp testing did show, under weaker signal conditions, that glideslope interference exists. It is not advisable to have man-made interference reduce the availability of the glideslope system further. Flying a glideslope signal under normal conditions could require maximum receiver sensitivity under certain conditions and that sensitivity can be affected by range, terrain or weather.
4. It is believed that a problem within the design of the TDFM-136 has been identified but it is beyond the scope of this facility to further identify the issues at hand that may cover the many various ILS approaches, makes and models of aircraft and avionics.

**Glossary**

- UUT – Unit Under Test
- 1200S – IFR FM/AM 1200S