IFF (Identification Friend or Foe) is the military designation for the Air Traffic Control (ATC) System that is used to identify and track military aircraft. The IFF system consists of a ground (or airborne, or shipborne) interrogator and an airborne transponder. The interrogator transmits a coded interrogation burst via a directional antenna, to which the airborne transponder replies with identification information according to the type of interrogation. The interrogator then determines the range and bearing to the target. Depending on the type of interrogation, the transponder may encode altitude, position, and other pertinent flight information.

IFF systems began in the 1940s with a single identification number reply, and was expanded to include altitude reporting and cryptographically secure identification in the 1960s. This design was referred to as the **Mark XII** standard, and it incorporated Mode 4 crypto IFF technology. Mode 4 IFF became a U.S. DoD-led standard throughout the NATO allied nations. The 1980s saw the introduction of commercial Mode S technology, which expanded IFF capability to allow two-way data communications between interrogators and transponders. This selective data communications improved air traffic control and enabled airborne traffic collision avoidance (TCAS) capability.

The development of the next generation military IFF (Identification Friend or Foe) system commenced in 1995 when the United States Joint Chiefs of Staff ordered the development of a new waveform (**Mode 5**) to replace the Mark XII Mode 4 IFF system. In 2002, NATO ratified STANAG (Standardization Agreement) 4193, which adopted the Mark XIIA Mode 5 IFF standard for the U.S. and NATO. The Mode 5 waveform uses modern modulation, coding, and cryptographic techniques to overcome performance and security limitations of the Mode 4 waveform. Additionally, Mode 5 systems provide expanded data handling capabilities to

securely pass GPS position and other aircraft data. Mode 5 uses spread spectrum techniques to overlay additional data transmissions on existing 1030 and 1090 MHz ATC frequencies without increased interference.

The U.S. Navy led this development project with the assistance of a multi-national working group representing NATO. The U.S. Navy, acting as the LPO (Lead Program Office) for the DoD (Department of Defense), has been the driving force in the U.S. for the development of Mode 5 technology. In the United States, BAE, Raytheon and Telephonics introduced Mode 5 aircraft radios in the 2007 timeframe. Internationally, Leonardo, Thales, and Hensoldt have also introduced Mode 5 radios for their respective markets. This led to a massive aircraft retrofit program for the United States and its NATO allies that has continued beyond the June 30, 2020 date for the decertification of Mode 4 IFF by the NSA. Since that time, Mode 5 has been the only IFF system in use by the U.S. military and NATO countries. Mode 5 uses several different crypto types that have been developed by various companies.

Mode 5 technology continues to evolve with several domestic companies developing micro Mode 5 transponders for UAV/drone applications.
Current efforts are underway by the U.S. military to evaluate Mode 5 Level 2-Broadcast, or M5L2-B. This is an implementation of Mode 5 whereby the airborne transponder autonomously transmits, encrypted periodic identification and flight position/status information. It is similar to commercial aviation ADS-B. It reduces the need for ATC interrogations and can be used to aid aircrews in airborne situational awareness (SA).

Also under development is Reverse IFF systems, a concept in which the transponder can be utilized to allow a pilot to scan for surface friendly targets. This concept uses the transponder to seek friendly ground based on receiving Mode 5 interrogations and displaying them as friendly targets, thus eliminating possible friendly fire upon ground equipment and missile/defense systems.
The Mode 5 crypto devices (appliques) have also been developed under several different key leaders in the Mode 5 market. The three most relevant CCI appliques developed are the KIV-77 (Option A variant) developed by General Dynamics, the KIV-77 (Option B Variant) developed under Raytheon Corporation and the SIT 2010 by Hensoldt. Other appliques are now being developed for the UAV market to reduce size and weight including the Mini IFF Appliques.

The governing body and standards office for Mode 4 and 5 is managed by the US Air Force AIMSPO (AIMS Program Office) who is in charge of developing and standardizing the Mode 4/5 program to ensure that all Transponder/Interrogator and CCI devices meet minimum criteria to ensure proper interoperability between different devices. STAGNAG, the NATO standardization agreement, also provides guidance and standardization for European NATO countries.

Though Mode 4 has been discontinued by the US and NATO, it still serves a purpose for non-NATO countries such as India and South Africa. By utilizing the original specifications, non-NATO countries have been developing custom adapted IFF algorithms, key generation systems and distribution for National Forces not able to have access to Mode 5.

Tel Instrument Electronics Corp. (TIC) has been a leader in IFF flight-line test sets for over 30 years. It received a U.S. Navy contract in 2005 to design and produce a Mode 5 multi-purpose flight-line test set (the AN/USM-708) and a companion IFF test set (the AN/USM-719) for shipboard use. In 2009, TIC received a U.S. Army contract to supply the Army and U.S. Air Force with new TS-4530A Mode 5 IFF “point-and-shoot” Mode 5 flight line testers. Since then, TIC has continued to innovate and expand its Mode 5 test capability with the T-47/M5 IFF tester for conducting AIMS platform certification testing. It can support both Option A and B crypto devices and works with the European SIT-2010 crypto device. The T-4530i flight line tester also provides additional testing capability and supports the use of the SIT-2010 crypto device. TIC has sold over 6,000 Mode 5 flight-line test sets to the U.S. military, Primes and most of our foreign allies.

TIC’s current efforts include developing test support for Mode 5 Level 2-Broadcast and supporting microIFF transponders for UAV/drone applications. TIC is committed to being the leading supplier and innovator in Mode 5 IFF flight line test equipment.