

# FAST Radio Communication and Visual Signals

## 1.1 Formation Radio Procedures

Voice is the primary means of communication between the flight leader and other flight members. All communication must be clearly understood by every flight member. Radio discipline requires not only clarity and brevity in the message, but limiting unnecessary transmissions, as well.

### 1.1.1 The Two-Step Communication Process

Formation radio communication is actually a two-step process. The first part of any radio call is the attention or preparatory step. This step serves to alert the listener that a message is coming and to specify to whom the call is directed. The attention step should always be the receiver's full call sign regardless of who initiates the call.

“Raven...” (call sign for entire flight)

The second part is the instruction/execution step, and tells the flight member, or members, the action to be taken or information to be passed:

“...go extended trail”

The flight members should acknowledge with full call sign, and any information requested, unless briefed otherwise.

- #2: “Raven 2”
- #3: “Raven 3”
- #4: “Raven 4”

It is important to note that this basic communication procedure is not limited to calls made by the flight lead; any flight member *initiating* a call will use the receiver's full call sign to preclude confusion, and the flight member the call was addressed to will acknowledge with his/her full call sign.

### 1.1.2 Frequency Change and Check-In Procedures

All flight members must maintain the capability to communicate with one another. Check-in and frequency switching procedures are critical to achieving this objective. When acknowledging simple instructions such as a frequency change or check-in, *within the flight and in sequence*, wingmen may respond with position number only, unless briefed otherwise. On the other hand, if responding out of sequence, or if separated from the flight, revert to full call sign use to avoid confusion.

- Flight lead: “Raven, go 121.8”
- #2: “2”
- #3: “3”
- #4: “4”

With all pilots responding, the entire flight will then switch

to the new frequency. If one or more pilots do not respond, all pilots will remain on frequency until Lead sorts out the comm problem—once this is accomplished, the entire flight will switch to the new frequency. The flight leader will then initiate the check-in with the wingmen responding with position number sequentially:

- Flight lead: “Raven, check”
- #2: “2”
- #3: “3”
- #4: “4”

At this point, the leader knows that all flight members are on the same frequency and he can now proceed with ops transmissions. This process of check-ins and frequency change protocols will be used on the ground or in flight as briefed.

#### NOTE

There are situations where the use of abbreviated call signs will not compromise situational awareness and is acceptable. It is the responsibility of the flight leader to make that determination and brief the comm plan accordingly.

## Lead

It is your responsibility to brief how radio operations will be performed during the flight. Before calling for a frequency change, place the flight in route formation. Ensure all calls are clear and concise, and combine calls when practical. Although frequency changes may be called at your discretion, delay the flight check-in as needed based on the wingman's capabilities.

If a wingman does not respond to repeated radio calls, the wayward wing pilot may be experiencing radio equipment failure, simply misunderstood the frequency, or mischanneled the radio. In these situations, you should pass the frequency via hand signals to him/her (see hand signals: 2.1.9 or 2.1.10). Following the hand signals, You will once again attempt to check-in the entire flight on the radio.

You speak for the flight to all agencies until the flight splits up.

#### NOTE

The flight leader will include the number of aircraft in the flight and his/her tail number on initial contact with Air Traffic Control: “Knoxville Ground, November Five Five Echo Mike, flight of four, taxi with information kilo”

**Wing**

Change radio frequency only when directed and only after all flight members have acknowledged with flight position number unless directed or briefed otherwise. If you do not understand the call, do not acknowledge—request the frequency or applicable information be repeated (“Raven 1, Raven 3, say again”).

If Lead calls for a frequency change in flight without moving the flight to route, you should move to route position, stabilize and proceed with the channel change. Do not return to fingertip until Lead directs you, unless briefed otherwise.

**1.2 Bomber/Transport Aircraft**

Radios are the primary means of communication among bomber/transport aircraft. Two radios are required for all bomber/transport formation flight. Both pilots must be capable of receiving and transmitting on both radios.

Except for these few emergency signals, visual signals will not be used and holders of FAST bomber/transport formation cards will not be responsible for them:

Attention in the air: Execute rapid, shallow wing rock

Can't hear: Move flat palm back and forth across ear

Can't transmit: Move flat palm back and forth across mouth

Systems failure: see HEFOE signals in paragraph 9.1.5

**2.1 Terminate Call**

Call “Terminate” to direct a specific aircraft or flight to cease maneuvering and to proceed as directed. Use “terminate” when safety of flight is not a factor, or as briefed. This call is particularly useful during formation training to inform the flight lead that all desired training has been achieved for a given phase of maneuvering. When hearing a terminate call, all flight aircraft will clear flight paths, stabilize in their current position, and await Lead's instructions.

**2.1.1 Terminate Procedures**

All flight members will acknowledge in order with their call sign and position number. In this example, Raven 3 has completed the desired learning objective:

“Raven 3, terminate” (deputy lead)

“Raven 1, terminate” (flight lead)

“Raven 2, terminate”

“Raven 3, terminate”

“Raven 4, terminate”

**NOTE**

In the context of multiple flights, such as large airshow formations, the terminate call would be used to cease maneuvering by a specific aircraft or flight only, not the entire airshow.

**2.1.2 Call Terminate When**

- The desired learning objective is achieved
- Warranted by the situation and KIO is not called for

**3.1 Visual Signals**

Visual signals can be used to communicate most of Lead's instructions during a formation sortie. However, radios should be used if there is an emergency, time is critical, or if visual signals are creating confusion. Any non-standard visual signals will be thoroughly briefed before they are used. All members of the flight must be familiar with the visual signals to be used. Normally, aircraft malfunctions or safety related issues will be communicated over the radio.

Visual signals can be communicated by hand or by aircraft movement. Some hand signals have a corresponding aircraft signal and can be used interchangeably at the discretion of the flight leader.

It is the responsibility of the flight lead to ensure that all members of the flight have a clear understanding of the signals to be used.

Wingmen will acknowledge Lead's hand signals with a distinct head nod and then execute the directed maneuver.

**3.1.1 Engine Start**

Extend arm over head and make a circular motion with the hand

**3.1.2 Engine Run-Up**

Extend arm over head and make a circular motion with the hand

**3.1.3 Ready for Takeoff**

After run-up, flight/element lead looks at wingman—wingman nods head yes or no

**3.1.4 Start Takeoff Roll**

Lead places head back toward headrest and nods head for brake release

**3.1.5 Gear Up**

Clenched fist, thumb up, upward motion of hand—head nod to execute

**2.1.6 Gear Down**

Clenched fist, thumb down, downward motion of hand—head nod to execute

**2.1.7 Flaps Up/Down**

Thumb and fingers together, opening and closing—head nod to execute

**3.1.8 Go to Route**

Lead will yaw/fishtail the aircraft

**3.1.9 Change Frequency**

Tap ear with fingers extended—extend finger(s) vertically for the digits one through five, horizontally for six through nine, pulling hand down out of sight between digits. Signal zero with a clenched fist.

**3.1.10 Change to Pre-Briefed Frequency**

Tap ear with index finger, extend fingers to correspond to the number of the pre-briefed frequency (tac 1, tac 2)

**3.1.11 Reform/Tighten Formation**

Rock wings smartly

**3.1.12 Cross-Under (hand signal)**

Cross #2 (2-ship)—Lead's arm bent 90°, fist clenched

Cross #2 (4-ship, fingertip to echelon)—Lead first signals #3 with arm bent 90°, fist clenched to indicate that #3 should move out to make room for #2. Lead then gives #2 the same signal.

Cross #2 (4-ship, echelon to fingertip)—Lead signals #2 with arm bent 90°, fist clenched

Cross #3/#4 (second element)—Lead's arm bent 90°, fist clenched, two arm pumps. If in echelon, Lead signals #2 and #2 relays the signal to #3 without taking his/her eyes off Lead

**3.1.13 Cross-Under (aircraft signal)**

To cross #2, Lead executes a quick, distinct wing dip in the direction he wants the wingman to cross.

- From fingertip strong left, a wing dip to the left would direct #2 to cross to the left side. The deputy lead (#3) would move the element out to make room for #2.
- From echelon left or right, a wing dip away from the echelon would move #2 to the opposite side.

To cross #3/#4 (second element)—Lead executes two quick, distinct wing dips in the direction he wants the second element to cross.

- From fingertip, two wing dips away from the second element would direct a cross-under of the second element to join #2 for the echelon.
- From echelon left or right, two wing dips away from the echelon would move the second element to the opposite side.

**3.1.14 Climb**

Palm flat, motioning in a forward and upward direction

**3.1.15 Descend**

Palm flat, motioning in a forward and downward direction

**3.1.16 Level Off**

Palm flat, moved back and forth in a horizontal motion

**3.1.17 Add Power**

Clenched fist, arm in forward motion

**3.1.18 Reduce Power**

Palm open, facing rearward, motioning to rear

**3.1.19 Stack Down**

Palm of hand facing downward with downward motion

**3.1.20 Stack Up**

Palm of hand facing upward with upward motion

**3.1.21 Echelon Turns (2-ship)**

Forefinger and pinky finger extended from clenched fist, held up for each echelon turn to be performed

**3.1.22 Fingertip to Diamond**

Lead's arm bent 90°, fist clenched, four fingers extended upward, followed by closed fist with thumb extended rearward, motioning aft. Number 3 relays this signal to #4 without taking his/her eyes off Lead. Number 4 calls in position.

**3.1.23 Fingertip to Trail (hand signal)**

Lead motions aft with clenched fist, thumb extended rearward

**3.1.24 Fingertip to Trail (aircraft signal)**

Lead gently porpoises aircraft several times

**3.1.25 Pitchout**

Clenched fist, with index finger held up and rotated, followed by number of fingers raised to indicate break interval in seconds

**3.1.26 Kiss Off**

Salute or other similar signal given by Lead just before he initiates a pitchout, symbolically “kissing them off” as the flight breaks into individual aircraft

**3.1.27 Lead Change**

Lead points to pilot he wants to assume lead, then points to front. Pilot so designated will acknowledge the signal by patting the top of his head and pointing forward.

**3.1.28 Fuel Check**

Clenched fist, thumb extended toward mouth in a drinking motion

**3.1.29 Fuel Remaining (in response to fuel check)**

Use up to five fingers to indicate each ten minute increment of fuel remaining as follows:

One finger = 10 to 19 minutes, fuel remaining

Two fingers = 20 to 29 minutes

Three fingers = 30 to 39 minutes

Four fingers = 40 to 49 minutes

Five fingers = 50 to 51 minutes

**3.1.30 Speed Brakes**

Hand up, palm forward, with head nod for execution

**3.1.31 Oxygen Check**

Cup hand over mask, followed by query in the form of an OK sign (circle formed by touching ends of thumb and forefinger, other fingers extended)

**3.1.32 Pitot Heat On**

Pinky finger extended out from clenched fist

**3.1.33 Landing Lights**

Pinky and index finger extended from clenched fist—upward for lights on, downward for lights off

**3.1.34 Rotating Beacon On**

Hand held up, fingers together, thumb apart in cupping shape, rotate hand at wrist

**3.1.35 Stop Squawk (transponder off)**

Hand clutched to throat in a choking motion

**3.1.36 OK or Ready to Go (on ground, not on active runway)**

Thumbs up

**3.1.37 Go Around**

Clenched fist, arm in forward motion

**Lead**

You will strive to make visual signals easy to see. Hand signals will be placed in the cockpit against a contrasting background to make them as visible as possible. Aircraft movements and wing-rockers will be big enough to be easily discernible. If a wingman does not acknowledge a signal, it should be interpreted as a request for clarification. Repeat the signal or make a radio call. Do not hesitate to use the radio to avoid confusion.

**Wing**

Acknowledge Lead's hand signals with an exaggerated head nod that is easy to see. Do not acknowledge any unclear visual signals—maintain position until receiving clarification or a repeat of the signal. Lead will repeat the signal until an acknowledgment is received from you. Pass visual signals on to other wingmen as appropriate. However, while in formation, do not look away from your leader's aircraft for acknowledgment from other wingmen. Do not hesitate to use the radio to avoid confusion.

**4.1 Ops Checks**

In-flight checks include any prescribed checklists (climb, enroute, descent) for that particular aircraft as well as periodic systems and fuel quantity checks termed "ops checks" (operational checks). The ops checks allows all pilots to briefly analyze fuel state, engine parameters, G-meter read-

ings and any other parameter desired. All in-flight checks will be accomplished in route formation or extended trail. The flight lead will brief how fuel states will be reported, such as total time, or total fuel on board.

**Lead**

You will pre-brief and direct required checklists (climb, enroute, decent) and periodic ops checks using a visual signal or radio call. Move all aircraft to route formation and avoid unnecessary maneuvering to allow wing pilots time to accomplish necessary cockpit tasks. You can also initiate an ops check when the flight is stabilized in extended trail. You can initiate the ops check with the following call:

"Raven, ops check, 55 minutes"

**Wing**

Upon receiving a radio call or visual signal for an ops check, move out to route formation if not already directed and perform the check. Continue to focus your attention on Lead, using only short glances to accomplish cockpit duties. Stay in route until Lead directs otherwise. For ops checks or fuel checks, Lead will expect you to acknowledge with total fuel remaining in time (hours/minutes), or total fuel on board, however briefed.

"Raven 2, 45 minutes"

After the check is complete, Lead will rock you back into your original position.

**5.1 Fuel Management**

Aircraft in formation often experience unequal fuel consumption rates so fuel management will play a vital role in mission planning and execution.

**5.1.1 Joker Fuel**

Joker fuel is the pre-briefed fuel state used to prioritize the remainder of the mission based on Lead's mission objectives. An example is terminating area work and accomplishing a recovery for multiple patterns. Upon reaching joker fuel status, the radio call is "Raven 2, joker." Lead will prioritize any remaining maneuvers as briefed and plan to recover the flight not later than bingo.

**5.1.2 Bingo Fuel**

Bingo fuel is a pre-briefed minimum fuel state which allows for safe return to base with necessary fuel reserves. Bingo will not be overflowed, as it would preclude a safe recovery. In dissimilar aircraft formations, for planning purposes, the normal burn rates will not be identical among all aircraft. For this reason, Lead may brief bingo fuel in time remaining instead of pounds, gallons or liters. If an aircraft reaches bingo fuel, the required call is "Raven 2, bingo."

**Lead**

You should carefully plan the sortie to determine appropriate joker and bingo fuel. Carefully consider briefed forecasts and current conditions, as well as other factors that may re-

quire additional fuel. In formations consisting of one aircraft type, you may brief to report fuel in total pounds, gallons or liters as the case may be. If flying a dissimilar aircraft formation, careful consideration should be given to each aircraft's operating parameters and fuel endurance. In these cases, it is advisable to reference fuel planning in time rather than gallons/liters, etc. This may be briefed as total time remaining, or time above bingo. If informed a wingman is bingo fuel, terminate maneuvers and expeditiously begin recovery to the planned destination.

### Wing

On the wing, you will typically burn more fuel than Lead, so monitoring fuel will be important. Lead will consider this in designing and executing the flight profile or cross country mission. However, you have the responsibility of monitoring your own fuel state. Inform the flight lead when reaching joker or bingo and get an acknowledgment.

## 6.1 Knock-It-Off (KIO)

The term "knock-it-off" may be used by any member of the formation to direct *all* aircraft to cease maneuvering and will be used when *safety of flight* is a developing factor. If danger is imminent, a directive call should be made or break out executed. "Cease maneuvering" does not mean the flight will cease flying formation—the flight lead will decide on the appropriate course of action with the goal of providing a stable platform while clearing his/her flight path. Following a "knock-it-off" called during fluid maneuvering (rejoins or extended trail), all flight members will vigilantly clear their flight paths while terminating individual maneuvers and proceed as directed by the flight lead. For example, if the flight was in the process of executing a rejoin and the KIO call was made, all flight members would stabilize in their current position and wait for instructions from Lead.

### 6.1.1 KIO Procedures

Initiation of a knock-it-off will begin with the flight call sign, and "knock-it-off." If prudent, a short description of the hazard may be included, such as hard deck or traffic. This call will be followed by the flight acknowledging the call, in order. In the following example, Raven flight is flying an extended trail, fluid maneuvering exercise when Raven 3 realizes the flight is quickly approaching the briefed hard deck (lower altitude limit for maneuvering):

"Raven 3, knock-it-off, hard deck"

"Raven 1, knock it off" (flight lead)

"Raven 2, knock it off"

"Raven 3, knock it off"

"Raven 4, knock it off"

In this example, all aircraft were alerted to a safety of flight condition that was developing. Had the flight member witnessed imminent danger, a flight member's pending impact with the ground in this case, the call would instead be di-

rective in nature ("Raven 2, pull up!")

### 6.1.2 Knock-It-Off Situations

Transmit KIO when any of the following situations occur:

- A dangerous situation is developing
- Loss of situational awareness that can't be regained
- Violation of briefed area boundaries or flight through minimum altitudes has or is about to occur
- Recognized radio failure
- Bingo fuel inadvertently overflown such that a direct flight to primary or alternate is required
- Non-briefed or non-participating flight/aircraft enters area and is a potential hazard to the flight
- Over-G/exceeding briefed flight parameters
- Any flight member calls "knock it off"

## 7.1 Formation Break Out Procedures

The purpose of a break out is to ensure immediate separation and to avoid a mid-air collision.

### Lead

If a wing pilot has broken out of the flight, you may continue the current maneuver with the current power setting if doing so will aid in aircraft separation. If you have the wingman in sight, you can maneuver to obtain separation based on the wingman's altitude and position. You can also direct the wingman so as to maintain separation or effect a rejoin, as you desire.

### Wing

You must break out of the formation if you:

- Lose sight of your lead aircraft
- If you are unable to rejoin or stay in formation without crossing directly under or in front of Lead
- If you feel your presence in the formation constitutes a hazard.
- When you are directed to do so by Lead

If you have lost sight, clear, then break in the safest direction away from the last know position or flight path of Lead and other aircraft. One technique: "look for blue sky and pull" is appropriate for many situations but there may be conditions where you would actually pull toward the ground, depending on your attitude and relative location to the rest of the flight. Call the breakout and your altitude: "Raven 2, breaking out, climbing to 4500 feet."

After gaining safe separation, you should confirm that Lead is, or is not, in sight and transmit "visual," or "blind." If you have reacquired Lead, remain in the same general area but make no attempt to close on the flight until Lead directs you to rejoin.

**WARNING**

The wing pilot may encounter a hazardous situation in which an aggressive break out is inappropriate. For example, if the aircraft drifts into a position dangerously close to Lead, an aggressive breakout may possibly result in collision. In this situation, the wingman should move away from Lead, using smooth and positive control inputs as required.

**8.1 Lost Sight**

There may be situations where you momentarily lose sight of your reference aircraft while maneuvering and a breakout is not warranted. This occurs when spacing between aircraft is such that a mid-air collision is not an immediate concern. Examples would be losing sight after rolling out from a pitch-out several thousand feet in trail or during fluid maneuvering exercises, such as extended trail.

**8.1.1 The Blind Aircraft**

If the other aircraft is not in sight when anticipated and proximity does not warrant immediate breakout, you will notify the flight using the term “blind,” and state altitude:

“Red 2, blind, 5500 feet”

In some cases, heading information may be useful but avoid long transmissions or descriptions. If visual contact is regained, do not rejoin until directed to do so by your flight or element leader.

**8.1.2 The Visual Aircraft**

If Lead has not lost visual with the wing pilot, he/she will help the wingman reacquire visual contact by transmitting his/her position from the wingman’s perspective”

“Red 1 is visual, your right, two o’clock high”

In this situation, Red 2 simply needs to look to his/her two o’clock high to attempt to reacquire Lead.

In all cases, Lead should be directive and ensure altitude separation, if required. Lead will then decide on the appropriate course of action.

**8.1.3 Both Aircraft Blind**

If the pilots of both aircraft have lost sight of one another, they will immediately follow “knock-it-off” procedures. Lead will ensure altitude separation is established immediately and maintained until visual contact is restored.

**9.1 Abnormal and Emergency Comm****9.1.1 Radio Failure**

If an aircraft loses the capability to transmit or receive: “no radios” (NORDO), the flight should be terminated as soon as practical and the NORDO aircraft escorted to a suitable airport for landing.

A formation approach to a drop off on final should be flown with the NORDO aircraft in the wing position unless circumstances dictate otherwise. The leading pilot will make all appropriate radio calls and coordinate the go-around. Normally, the leading pilot will obtain landing clearance for the NORDO pilot and then execute a go-around at or above 300 feet AGL.

If the approach is executed from a 360° overhead pattern at a towered airport, the NORDO pilot should be alert to landing clearance as indicated by light signals from the tower controller.

**9.1.2 Attention in the Air**

Execute rapid, shallow wing rock

**9.1.3 Can’t Hear**

Move flat palm back and forth across ear

**9.1.4 Can’t Transmit**

Move flat palm back and forth across mouth

**9.1.5 System Failures—HEFOE**

The HEFOE signals are only intended for use when NORDO.

Hold clenched fist up to top of canopy and then hold up the number of fingers corresponding to the condition

Hydraulic/pneumatic = one finger

Electric = two fingers

Fuel = three fingers

Oxygen = four fingers

Engine = five fingers

**9.1.6 Aircraft Damage Assessment**

Pilot of damaged aircraft holds up clenched fist with index finger and thumb extended, back of hand towards canopy. Pilot then maintains a stable platform while wingman maneuvers to perform and inspection for possible damage.

**9.2 Coordination/Support for Damaged or Disabled Aircraft****9.2.1 Flying Chase**

The pilot providing coordination and support to a distressed pilot will fly a chase position, maneuvering in a route position, offset up to 45° aspect angle either side of the leading, distressed aircraft. Since the distressed pilot may be subject

to loss of aircraft control, aircraft structural failure or bailout/ejection, it is critical that the chase pilot fly only as close as is necessary to provide observation and support without creating a further hazard or distracting the distressed pilot.

#### WARNING

The chase pilot must avoid “over-controlling” the distressed pilot—this can be distracting and counterproductive to a successful outcome.

are closer than those originally planned. In any case, do not compound the emergency by flying beyond the minimum acceptable bingo fuel.

### 9.2.2 Responsibilities of the Chase Pilot

The chase pilot can provide a wide variety of support functions, some of which are listed below:

- Coordinate radio communication
- Coordinate emergency recovery
- Coordinate emergency rescue equipment
- Provide emergency checklist guidance
- Provide emergency landing guidance
- Provide visual inspection and feedback

### 9.3 Coordination/Support for Bailout/Ejection or Forced Landing

#### 9.3.1 Search and Rescue (SAR)

When a member of the flight has to bailout, eject or make a forced landing, timely communication is critical.

#### 9.3.2 Responsibilities of the SAR Commander

The SAR commander, normally the flight leader, will initiate the SAR effort. The following action items, though not necessarily appropriate for every emergency, should be considered as part of the response effort:

- **Respond:** Terminate maneuvering using KIO procedures. Establish a SAR commander. Remain above the last known position of the downed airman, using altitude separation to de-conflict with other SAR aircraft. Establish a high and low covering air patrol (SAR-CAP), if required to enhance radio communications.
- **Squawk:** select the emergency transponder code (7700) to alert air traffic control
- **Talk:** Communicate with the most suitable agency to initiate the SAR effort. In some instances this will be an air traffic controller and in other instances it will be a radio call to a local airport to advise local emergency rescue squad personnel via phone.
- **Mark:** Establish, as accurately as possible, the location of the downed airman using GPS, nav aids, a radar fix, or ground references.
- **Assess:** Try to determine the condition and needs of the downed airman—relay this information to the rescuing agency.
- **Bingo:** Be cognizant of fuel state. Bingo fuel can be revised to a lesser amount if there are recovery fields that