

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering

Vehicle Recorder Division

Washington, D.C. 20594



**GROUP CHAIRMAN'S FACTUAL REPORT OF
INVESTIGATION**

CEN20LA419

By

W. Deven Chen

WARNING

The reader of this report is cautioned that the transcription of a cockpit image and audio recording is not a precise science but is the best product possible from a Safety Board group investigative effort. The transcript or parts thereof, if taken out of context, could be misleading. The transcript should be viewed as an accident investigation tool to be used in conjunction with other evidence gathered during the investigation. Conclusions or interpretations should not be made using the transcript as the sole source of information.

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, DC 20594

January 29, 2021

Onboard Image Recorder

Specialist's Factual Report

By W. Deven Chen

1. EVENT

Location: San Marcos, Texas
Date: September 24, 2020
Aircraft: Cessna 172, N108VK; Team Rocket F-1, N540LK
Operators: Private (N108VK); Private (N540LK)
NTSB Number: CEN20LA419

2. GROUP

A group was convened on January 11, 2021 at the NTSB's Vehicle Recorder Laboratory in Washington, D.C.

Chairman: W. Deven Chen
Electrical Engineer
National Transportation Safety Board (NTSB)

Member: Sean Payne
Mechanical Engineer
NTSB

3. DETAILS OF INVESTIGATION

On October 8, 2020, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following image recorder recovered from the Cessna 172:

Recorder Manufacturer/Model: **GoPro HERO 8 Black**
Recorder Serial Number: **A1251324576422**

3.1. Recorder Description

The GoPro HERO is a compact, lightweight, POV¹ digital camera enclosed in a ruggedized housing that allows the camera to be mounted in a variety of positions using an array of supported accessories. Depending on the model, the camera supports 4K² HD³ at 60 frames

¹ POV – Point of View Shot – A photography technique that records the character's viewpoint from a singular camera location mounted in a manner that represents the character's field of view.

² 4K – A resolution format of 3840 x 2160 pixels.

³ HD – High Definition – A resolution generally consisting of greater than 480 lines of horizontal resolution.

per second (fps) as well as other lower quality recording resolutions at higher frame rates. The camera can be set to record still images simultaneously or independently of a video stream at a resolution of up to 12 megapixels.⁴ The camera includes a wide angle aspherical f/2.8 glass lens that provides a maximum of 170 degrees viewing angle. The camera supports recording to micro SD⁵ cards. A built in Wi-Fi⁶ module allows users to connect to the camera either via an accessory remote control or via a smart phone app that permits camera control and image transfer.

3.2. Recorder Data Recovery

Upon arrival at the NTSB Vehicle Recorder Division, the device did not have any obvious damage. The device's memory card was removed, and the video and audio information were extracted from the memory card. Figure 1 shows on the left, the GoPro mounted on a holder upon arrival at the Vehicle Recorder Laboratory, and the screen of the GoPro on the right.



Figure 1. The condition of the GoPro upon arrival at the laboratory.

3.3. Recorder Data Description

The memory card contained six video recording files in MP4 format. Per GoPro design, those six video files were split segments from one single recording session of the accident flight. Each of the first five video files had 11 minutes and 47 seconds in length and the last video file had eight minutes and 46 seconds. The collision was captured on the 5th video file.

The video recording contained an over the shoulder view of the Cessna 172 occupants and the instrument panel. The camera was mounted on the headliner of the aircraft behind and between the instructor pilot and the student pilot. Figure 2 is a redacted screenshot of the camera's field of view on the accident aircraft. The instructor pilot is in the right seat and the student pilot is in the left seat. The video contained audio recordings of intra-cockpit communication between the instructor pilot and the student pilot, as well as over the air radio

⁴ Megapixel – (MP) – A count of a million pixels in an image or used to express the number of individual image sensor elements on a digital camera image sensor.

⁵ SD – Secure Digital – a standard for nonvolatile memory card used in portable devices.

⁶ Wi-Fi – A local area wireless technology that allows electronic devices to exchange data over a network.

frequency communication, this was likely recorded via a connection to the aircraft's audio panel.



Figure 2. A redacted screenshot of the camera's field of view.

3.4. Timing and Correlation

The video recording contained timestamps. The timing of the video was converted to central daylight time (CDT) by aligning the aircraft position on the runway of Lockhart Municipal Airport on the video to the same position indicated by the aircraft's ADS-B⁷ data. The conversion may have an offset of up to +/- 2 seconds.

3.5. Summary of Recording and Transcript of the Contents

The transcription of audio begins after the aircraft had departed the Lockhart Municipal Airport, had exited the traffic pattern and had set a course toward the San Marco Regional Airport. At the time, the instructor pilot had just changed the frequency from the Lockhart UNICOM⁸ to the San Marcos UNICOM. The instructor pilot and the student pilot had just performed a verbal exchange of the flight controls. The student pilot was flying, and the instructor pilot was looking for traffic, changing settings on the Garmin GTN-650⁹ and monitoring the student pilot.

All audio from this moment until impact has been transcribed. This includes intra-cockpit communication between the instructor pilot and the student pilot which appears on the left column of the transcript and the radio frequency transmission which appears in the middle column of the transcript. Though it is not obvious in the transcript, transmissions on the San Marcos UNICOM were nearly constant, with very little dead air between pilots'

⁷ Automatic Dependent Surveillance-Broadcast (ADS-B) – a surveillance technology in which an aircraft determines its position via satellite navigation or other sensors and periodically broadcasts it, enabling it to be tracked.

⁸ A UNICOM (universal communications) station is an air-ground communication facility operated by a non-air traffic control private agency to provide advisory service at uncontrolled aerodromes and airports.

⁹ A GPS navigation system by Garmin.

communication. The San Marcos UNICOM frequency was crowded at the time of the accident.

Video actions were not transcribed until 19:15:22.4 when the aircraft was on downwind to runway 8 at San Marcos just prior to the accident. When transcribed, the video actions appear in the right column of the transcript. Prior to this time, the video actions of the instructor pilot were summarized here. In general, the instructor pilot's focus seemed to be consistent with detecting and deconflicting with other air traffic in the vicinity of the San Marcos airport. This included the instructor pilot constantly scanning outside of the aircraft for traffic. At times when the instructor pilot's focus was inside the cockpit, his actions were consistent with using the GTN-650's ADS-B information to deconflict air traffic. In general, when the aircraft was on a westerly heading, sun glare seemed to impact the occupants' abilities to scan for traffic ahead of them. The sun was low on the horizon and was visible through the windscreen during portions of the video recording.

Some features of the transcript that was generated should be highlighted. They are as follows:

- Pilots on the San Marcos UNICOM mis-identified San Marcos airport for Lockhart airport. This occurred twice by two different pilots.
- The commonality of tail numbers broadcasting on San Marcos UNICOM. The common tail numbers were as follows:
 - 1VK
 - 8VK
 - 4LU
 - 34LU
 - 30LU, 30LU
 - 0LK
- Transmissions by pilots on the San Marcos UNICOM appeared to be “stepped on”¹⁰ 4 times. In some instances of transmission being stepped on, parts of, or all the transmissions were garbled. As a result, up to 8 transmissions could have been affected by conflicting radio transmissions.
- Pilots on the San Marcos UNICOM used double-mic clicks as an acknowledgement to a transmission. This occurred twice.

¹⁰ “Stepped on” – Simultaneous radio broadcasts on the UNICOM frequency.

LEGEND

0LK	Radio transmission from Team Rocket F-1 540LK (accident aircraft)
1VK	Radio transmission from Skyhawk 1VK
2ND	Radio transmission from Skyhawk 512ND
2PR	Radio transmission from Helicopter 442PR
30LU	Radio transmission from Skyhawk 30LU
34LU	Radio transmission from 34LU (female)
4LU	Radio transmission from 4LU (male)
626	Radio transmission from Cessna 626
6318L	Radio transmission from Skyhawk 6318L
810SA	Radio transmission from Cessna 810SA
8VK	Radio transmission from Cessna 172 108VK (accident aircraft with the GoPro)
IP	Instructor pilot
MIC	GoPro ambient Microphone
SP	Student pilot
VC	Comments described from video recording (video comment)
?-RDO	Radio transmission from unidentified aircraft
*	Unintelligible word
#	Expletive
@	Non-pertinent word
()	Questionable insertion
[]	Editorial insertion

Note 1: Times are expressed in Central Daylight Time.

Note 2: Generally, only radio transmissions to and from the incident aircraft were transcribed.

Note 3: Radio transmissions from the accident aircrafts are highlighted in colors: Team Rocket F-1 540LK in red and Cessna 172 108VK in blue.

Note 4: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 5: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
1858:49.0					
START OF RECORDING					
START OF AUDIO TRANSCRIPT					
		19:08:33.3 2ND	San Marcos traffic - two-november-delta turning left crosswind. eight. San Marcos.		
		19:08:41.1 30LU	San Marcos traffic - skyhawk three-zero-lima-uniform turning base for runway zero eight touch-and-go. San Marcos.		
		19:08:50.5 1VK	San Marcos traffic - skyhawk one-victor-kilo left downwind of runway eight. San Marcos.		
		19:08:56.0 8VK	San Marcos traffic - skyhawk eight-victor-kilo six and a half to the east enter in a left downwind from runway eight. San Marcos.		
19:09:05.5 SP	what altitude you want?				
19:09:07.2 IP	uh eighteen hundred's fine.				
19:09:11.8 IP	just sidestep to the right a little bit that way we enter a left downwind for runway eight.				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
19:09:15.5 SP	'kay.				
19:09:16.5 IP	see that little dash line there.				
19:09:17.9 SP	yea.				
19:09:18.1 IP	your extended center line - so that would be runway eight - just get on to the ri-				
19:09:23.5 SP	right.				
19:09:23.9 IP	right side of that – yeah.				
		19:09:30.9 34LU	San Marcos traffic - skyhawk three-four-lima-uniform on the go runway eight left closed traffic. San Marcos. [Stepped on.]		
		19:09:35.6 ?-RDO	[Stepped on] * * * San Marcos traffic.		
		19:09:39.8 30LU	San Marcos traffic - skyhawk three-zero-lima-uniform on final for runway zero eight touch-and-go. San Marcos.		
19:09:59.6 IP	alright - kinda see the runway up there a little bit –				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
19:10:09.7 SP	yup.	19:10:01.6 0LK	San Marcos traffic - rocket five-four-zero-lima-kilo three miles to left forty-five - runway eight - descending out of four thousand.		
		19:10:18.0 6318L	San Marcos traffic - six-three-one-eight-lima - left base - runway eight. San Marcos traffic. full stop.		
		19:10:30.0 8VK	San Marcos traffic - eight-victor-kilo four and a half to the east gonna enter the left downwind runway eight. Lockha – err - San Marcos.		
19:10:37.5 IP	Lockhart.				
19:10:40.5 IP	alright see the taxiway over there?				
19:10:41.8 SP	yup.				
		19:10:42.1 2ND	San Marcos traffic - two-november-delta left downwind midfield eight. San Marcos.		
19:10:46.9 SP	juliette comin' around? that side – yeah.				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
19:10:50.5 IP	yeah - we'll get kinda lined up with juliette at least –				
19:10:52.8 SP	yeah.				
		19:11:12.1 30LU	San Marcos traffic - skyhawk three-zero-lima-uniform uh upwind for runway zero eight - touch-and-go. San Marcos.		
		19:11:24.4 4LU	San Marcos traffic - four-lima-uniform turning onto left downwind for touch-and-go on runway eight. San Marcos traffic.		
		19:11:33.5 6318L	San Marcos traffic - six-three-one-eight-lima turning final runway eight - full stop. San Marcos traffic.		
		19:11:38.6 0LK	San Marcos traffic - five-four-zero-lima-kilo left forty-five runway eight, following the Cessna.		
19:11:45.0 IP	right there?				
19:11:45.2 SP	yup.				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:11:48.3 1VK	San Marcos traffic - skyhawk one-victor-kilo left base over bobcat stadium - touch-and-go - for runway eight. Lockhart – errr - San Marcos.		
		19:11:57.2 8VK	San Marcos traffic - skyhawk eight-victor-kilo is left downwind - runway eight for full stop. San Marcos.		
		19:12:03.6 30LU	San Marcos traffic - uhh we have that eight-victor-kilo in sight. we'll follow behind ya for left.		
19:12:09.9 IP?	*				
		19:12:10.8 ?-RDO	[Sound similar to double mic click.]		
		19:12:11.3 0LK	aaand San Marcos - five-four-zero-lima-kilo is number two left downwind.		
		19:12:24.4 4LU	San Marcos traffic - four-lima-uniform - uh we're going to go ahead and extend our downwind for you all - er give you all as much space as you need. San Marcos traffic.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:12:39.4 2ND	San Marcos traffic - two-november-delta turning left base for eight - and we are also over the stadium. San Marcos.		
		19:12:49.7 1VK	San Marcos traffic - skyhawk one-victor-kilo, about a mile and a half final, number two for runway eight - touch-and-go. San Marcos.		
		19:12:56.9 810SA	San Marcos traffic - this is uhh - eight-one-zero-sierra-alpha, we'll hold short for runway uh two six. – correction runway eight.		
		19:13:08.5 30LU	San Marcos traffic - three-zero-lima-uniform turning downwind for runway zero eight touch-and-go. San Marcos.		
		19:13:15.1 ?-RDO	[Sound similar to a keyed microphone, could possibly be microphone stepped on.]		
		19:13:33.6 0LK	uh, San Marcos - zero-lima-kilo will make a right – three-sixty in for spacing.		
19:13:43.0 IP	* up abeam.				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
19:13:44.7 IP	yeh, go ahead make you (configuration) we're gonna be looking for this guyyy.				
		19:13:48.4 2ND	San Marcos traffic - two-november- delta - two and a half mile final - runway eight. San Marcos.		
		19:13:56.8 4LU	San Marcos traffic - four-lima-uniform turning left base over bobcat stadium for full stop on runway eight. San Marcos traffic.		
19:14:06.3 IP	alright, so people are extending to the stadium, let's see a line out there.				
19:14:09.4 SP	yup.				
19:14:10.1 IP	kinda look for that guy.				
		19:14:11.3 30LU	San Marcos traffic - three-zero-lima- uniform - uh - downwind midfield for runway eight, touch-and-go. San Marcos		
19:14:14.7 IP?	**				

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:14:19.2 0LK	ah, San Marcos traffic - zero-lima-kilo - make a right three-sixty on the left downwind - so we join the left downwind now. [Sound similar to radio transmission being stepped on.]		
		19:14:27.4 ?-RDO	[Remainder of transmission from line above, from another unidentified pilot.] for runway eight full stop. San Marcos.		
		19:14:31.1 6318L	San Marcos traffic - six-three-one-eight-lima off runway eight on bravo taxiing to coast. San Marcos traffic.		
		19:14:36.9 ?-RDO	is everybody's flying to San Marcos? [spoken sarcastically.]		
19:14:39.7 IP	tsssk. [Sound similar to quick exhale.]				
		19:14:39.9 ?-RDO	[Sound similar to double microphone clicks.]		
		19:14:44.7 4LU	San Marcos traffic - four-lima-uniform turning onto left final for full stop on runway eight. San Marcos traffic.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:14:54.5 2PR	San Marcos traffic - helicopter four-four-two-papa-romeo is heading to the north - position - to the southwest - positioning two miles off the field to look for traffic. San Marcos.		
		19:15:08.7 8VK	aircraft that did the right three-sixty on the downwind - have you rejoined?		
		19:15:14.2 0LK	Yeah. we-uh we're right about to turn left base - but I see a Cessna right below me.		
				19:15:22.4 VC	[The instructor pilot performed a non-verbal transfer flight control. The instructor pilot tapped the student pilot's right hand which was on the throttle. The student pilot removed his hand from the throttle. The instructor pilot now firmly grasped the throttle and yoke. The instructor pilot now appeared to be manipulating the flight controls. The student pilot still had his hand on his yoke. The instructor pilot input a left bank angle. The aircraft began rolling left onto a left base leg to runway 8. During this time, the instructor pilot was looking in all directions outside the aircraft.]

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:15:26.4 8VK	All right - that might be us. We're - over the stadium turning a left base for eight. victor-kilo.		
		19:15:37.0 0LK	* zero-lima-kilo. we'll extend a little bit - and then we'll rejoin on the final.		
				19:15:42.3 VC	[The instructor pilot pointed upward and outside the aircraft as the aircraft continued to roll left bank. The instructor pilot continued to look through left turn.]
		19:15:42.9 8VK	okay. we see you up there over the stadium (we do).		
		19:15:45.2 810SA	San Marco traffic - Cessna eight-one-zero-sierra-alpha taking active runway eight. San Marcos traffic.		
		19:15:51.2 4LU	San Marcos traffic - four-lima-uniform short uh - final on runway eight.		
				19:15:58.3 VC	[The altitude indicated 1000 feet. The instructor pilot was sole manipulator of the control at this time. The instructor pilot was looking outside the aircraft the whole time.]

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
19:16:10.7 IP	alright, I'm gonna get us set back up onto here.	19:16:02.3 30LU	three-zero-lima-uniform. We're going to go ahead and extend our downwind to let the other plane in.		
		19:16:16.1 ?-RDO	delta uh – delta uniform one two uh - you going in pattern or leaving?		
				19:16:21.7 VC	[The instructor pilot re-ranged the GTN-650's zoom scale and slightly changed the heading of the aircraft. The altitude now indicated 1100 MSL. The instructor pilot's view was primarily outside of the aircraft.]
		19:16:24.5 0LK	ahh San Marcos - five-four-zero-lima-kilo is over thirty-five inbound for landing on final for runway eight.	19:16:24.5 VC	[The Cessna 108VK (accident aircraft) crossed Highway 35.]
				19:16:32.6 VC	[The student pilot first guarded the yoke with his left hand and then lightly grasped the yoke with his left hand. The instructor pilot had his hands on the yoke and throttle. The altitude indicated 1100 MSL.]
		19:16:33.3 8VK	San Marcos traffic - skyhawk eight-victor-kilo two mile final runway eight. San Marcos.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
				19:16:38.7 VC	[The instructor pilot was looking in all directions outside of the aircraft, including upward and later, behind the aircraft.]
19:16:40.4 IP	I have no idea this guy sees us doesn't see us.				
19:16:49.0 IP	flaps ten, we're just keep it going in there.				
		19:16:52.6 626	San Marcos traffic - Cessna six-two-six, we're three miles away - we're looking to join a forty-five on the downwind for eight to get into pattern for a full stop.		
				19:17:04.3 VC	[The student pilot released his left hand from the yoke and was not present on the yoke for the remainder of the recording. The instructor pilot ran an abbreviated before-landing checklist muscle memory flow with his left hand and added another notch of flaps. The altitude indicated 1100 MSL.]
		19:17:05.2 30LU	San Marcos traffic - skyhawk three-zero-lima-uniform making a left base over campus for runway zero eight touch-and-go. San Marcos traffic.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:17:15.1 0LK	uh - zero-lima-kilo is about one mile final for runway eight.		
		19:17:20.2 810SA	San Marcos traffic - uh - eight-one-zero-sierra-alpha departing pattern to the east. San Marcos traffic.		
				19:17:25.6 VC	[The instructor pilot quickly looked outside of the aircraft, including upward and behind the aircraft. In general, the instructor pilot's action seemed consistent with looking for and deconflicting other air traffic.]
		19:17:25.7 8VK	San Marcos traffic - eight-victor-kilo is on point eight for runway eight. San Marcos.		
		19:17:32.1 *VK?	San Marcos traffic - (skyhawk) * (victor kilo) is left downwind for runway eight [Radio transmission stepped on.]		
		19:17:37.6 ?-RDO	[Continuation of transmission that was stepped on.] – through twenty one hundred for up to three thousand five hundred. San Marcos.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
		19:17:43.6 30LU	San Marcos traffic - skyhawk three-zero-lima-uniform is on a long final over thirty-five for zero eight. San Marcos traffic.		
				19:17:52.1 VC	[Up until this point, while the aircraft was on the final approach, the instructor pilot was looking all directions. From this time forward, the instructor pilot stopped looking other directions and focused his attention forward of the aircraft towards the runway. The altitude indicated 750 MSL.]
		19:17:52.3 4LU	San Marcos traffic - four-lima-uniform clear of runway eight on bravo, going to taxi on alpha back to coast. San Marcos traffic.		
		19:18:00.4 ?-RDO	San Marcos traffic this is --		
19:18:02.2 MIC	[Sounds of aircraft collision.]				

19:18:03.1

VC

[Impact occurred. The instructor pilot was the sole manipulator of the flight controls at this time. The altitude indicated around 660 MSL.

Indication of the impact occurred in the region of the top left wing of the Cessna. Upon impact, the Cessna began rolling left. The propeller of the Rocket F-1 was visible throughout the impact sequence moving toward the region of the Cessna's upper left cowling. The Rocket F-1's propeller was later visible stopped. The left side of the Cessna windscreen had shattered, and the occupants of the Cessna appeared to use their arms to guard themselves at times. As the Cessna descended toward the ground, it continued to reach an almost 90-degree left roll. Throughout the impact sequence, the student pilot appeared to move backwards on the seat and guarded his face with his hands. The student pilot did not appear to influence the control of the aircraft during the impact sequence. The instructor pilot used his left hand to guard his face, and when his right hand was visible, he was making right roll input on the yoke. Later in the sequence, both hands of the instructor pilot were making a right roll input on the yoke. At times, when the flight control was not visible, the instructor pilot's body position suggested his right hand remained on the yoke with a right roll command until the impact with the

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication	Time and Source	Video Comments
					ground. The aircraft impacted the ground nearly wing level.]
19:18:05.1 MIC	[Sounds of impact.]				
1922:24.4 END OF TRANSCRIPT END OF RECORDING					