Test Report

CFR Title 47 Sections:
Part 2 (2.201, 2.202, 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055),
Part 80 (80.209, 80.211, 80.213, 80.215, 80.273)

for

Trade name: Furuno
Model: Transceiver for Radar Sensor DRS12A-NXT
Type: RTR-125

Report no.: LIC 12-19-118,
Rev.1

Date of Revised issue: 8 October 2019

Labotech International Co., Ltd.
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Report Summary

<table>
<tr><td>LIC project number:</td><td colspan="5">LIC 04-19-0334</td></tr>
<tr><td>Test report number of initial issue:</td><td colspan="3">LIC 12-19-118</td><td>Date of initial issue</td><td>27 August2019</td></tr>
<tr><td>Test report number of revised/replaced issue:</td><td colspan="3">LIC 12-19-118, Rev.1</td><td>Date of revised/replaced issue</td><td>8 October 2019</td></tr>
<tr><td rowspan="2">Test report revision/ replacement history:</td><td>Rev. No</td><td>Date</td><td>Page</td><td>Item</td><td>Description of change/reason</td></tr>
<tr><td>1</td><td>8 Oct. 2019</td><td>10-11</td><td>3.1 RF Power Output</td><td>- Error was corrected.
(*1) P_p (W) = (P_m (W) / (T (μs) × PRF (Hz))) × 1000
→ (*1) Pp (W) = (Pm (W) / (T (μs) × PRF (Hz))) × 1000000</td></tr>
<tr><td>Test standard(s)/
Test specifications:</td><td colspan="5">CFR Title 47 Sections:
2.201 - Emission, modulation, and transmission characteristics
2.202 - Bandwidths
2.1046 - RF Power Output
2.1047 - Measurements required: Modulation Characteristics
2.1049 - Occupied Bandwidth
2.1051 - Spurious Emissions at Antenna Terminals
2.1053 - Field Strength of Spurious Radiation
2.1055 - Measurements required: Frequency Stability

80.209 - Transmitter frequency tolerances
80.211 - Emission limitations
80.213 - Modulation requirements
80.215 - Transmitter power
80.273 - Radar standards

(the latest version on the first day of the testing period)</td></tr>
<tr><td>Customer:</td><td colspan="5">Furuno Electric Co., Ltd.
9-52, Ashihara-Cho, Nishinomiya-City, Hyogo, 662-8580 Japan</td></tr>
<tr><td>Manufacturer:</td><td colspan="5">Furuno Electric Co., Ltd.
9-52, Ashihara-Cho, Nishinomiya-City, Hyogo, 662-8580 Japan</td></tr>
<tr><td>Trade name:</td><td colspan="5">Furuno</td></tr>
<tr><td>Model:</td><td colspan="5">Transceiver for Radar Sensor DRS12A-NXT</td></tr>
<tr><td>Type:</td><td colspan="5">RTR-125</td></tr>
<tr><td>Product function and intended use:</td><td colspan="5">Navigation radar for use on non-SOLAS vessels</td></tr>
<tr><td>Number of samples tested:</td><td colspan="5">One</td></tr>
<tr><td>Serial number:</td><td colspan="5">1001-2100-0001</td></tr>
<tr><td>Power rating:</td><td colspan="5">24 VDC</td></tr>
<tr><td>Product status:</td><td colspan="5">Pre-production model</td></tr>
<tr><td>Modifications made to samples during testing:</td><td colspan="5">None</td></tr>
<tr><td>Date of receipt of samples:</td><td colspan="5">19 June 2019</td></tr>
<tr><td>Test period:</td><td colspan="5">From 19 June 2019 to 31 July 2019</td></tr>
</table>

Place of test:	Labotech International Co., Ltd. FCC Test firm Designation Number: JP2007 FCC Test firm Registration Number: 838049 - LABOTECH EMC Center 1-16, Fukazu-cho, Nishinomiya-shi, Hyogo, 663-8203 Japan - Nishinomiya Lab. 9-52 Ashihara-cho, Nishinomiya-shi, Hyogo, 662-8580 Japan
Test results/Compliance:	Passed. The test results of this report relate only to the samples tested.
Tested by:	Akihiro Sakai, Atsushi Takagi and Koji Kawai
Written by:	Arisa Ogino
Verified by:	Tadayuki Ekawa
Approved by:	8 October 2019 Name: Tadayuki Ekawa Title: Head engineer, Technical Department Labotech International Co., Ltd. Signature: T. Ekawa

Testing Laboratory Status

Labotech International Co., Ltd. (hereafter called “LIC”) has been holding the following status after having been assessed according to the provisions of ISO/IEC 17025 and/or the relevant rules:

(1) JAB Accredited Testing Laboratory:
- accredited by Japan Accreditation Board (JAB)
- Laboratory accreditation number: RTL03220 (Date of initial accreditation: 14 January 2011 (*))
- Scope of accreditation: Electrical testing - EMC, Climatic, Vibration and Radio tests

(2) Telefication Listed Testing Laboratory:
- listed by Telefication B. V., (The Netherlands)
- Laboratory assignment number: L116 (Date of initial listing: 26 July 1999 (*))
- for testing the following product categories/ test standards: EN 60945, IEC 61162-1/-2, IEC/EN 61162-450, IEC 62288, ETSI EN 301 843-1 / -2, ETSI EN 301 489-1 / -3 / -17

(3) TÜV Appointed EMC Test Laboratory:
- appointed by TÜV Rheinland Japan Ltd.,
- Laboratory assignment number: UA 50046428 (Date of initial appointment: 21 December 1998 (*))
- for carrying out the tests of EMC emission and immunity

(4) RMRS Recognized Testing Laboratory:
- recognized by Russian Maritime Register of Shipping (Russia)
- Laboratory recognition number: 17.13259.170 (Date of initial recognition: 27 January 2009 (*))
- for carrying out testing in the field of:
  Electrical measurements and tests, EMC tests, Mechanical measurements and tests, Equipment protection degree tests, and Climatic tests for Ship's radio and navigational equipment and IEC 60945: 2002

(5) RRR Recognized Test Laboratory:
- recognized by Russian River Register (Russia)
- Certificate number: 131927 (- Date of initial recognition: 31 May 2013 (*))
- for carrying out of tests of ships radio and navigation equipment

(6) DNV GL Recognized Environmental Test Laboratory:
- recognized by Det Norske Veritas AS, Germanischer Lloyd (Norway)
- Recognition certificate number: 262.1-015854-J-12 (Date of initial recognition: 12 July 2013 (*))
- Scope of recognition: Testing according to the standards IEC 60945, IEC 61162-1/-2/-450, IEC 62288, IEC 62388 and IEC 62252 Annex E
- Application: Provisions of Environmental, interface and safety testing.

(7) CCS Recognized Test Agency:
- recognized by China Classification Society
- Recognition certificate number : DB13A00001 (Date of initial recognition : 29 January 2014 (*))
- Scope of recognition : Performance/Environmental/EMC/Special purpose/Safety precautions tests for Electrical & Electronic Product including Maritime Navigation and Radio-communication Equipment & Systems

(8) SABS EMC A-Lab program Laboratory:
- recognized by South African Bureau of Standards
- Assigned Lab number : SABS/A-LAB/0042/2018 (Date of initial recognition : 5 July 2018 (*))
- Approved List of EMC Standards : SANS 211 / 214-1 / 214-2 / 222 / 2332 / 2335, CISPR 11 / 14-1 / 14-2 / 22 / 32 / 35, SANS/IEC 60601-1-2, SANS/IEC 61326-1, IEC 61326-2-6, SANS/IEC 61000-3-2 / -3-3 / -4-2 / -4-3 / -4-4 / -4-5 / -4-6 / -4-8 / -4-11 / -6-1 / -6-2 / -6-3 / -6-4

(9) A2LA accreditted Testing Laboratory:
- accredited by American Association of Laboratory (A2LA)
- Certificate number: 5241.01 (Date of initial accreditation: 17 Jul 2019 (*))
- Scope of accreditation: Electrical testing - Emissions - Radiated and Conducted, Radio - Maritime Radio Systems, Stations in the maritime services, Private land mobile radio service, Radio / Intentional radiators, RF Exposure and EMC - Automotive Electronic Devices (AED), Machine and Vehicle

(*) The latest certification status may be found on the LIC website (https://www.labotech-intl.co.jp/).

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1 Principal Information
1.1 Equipment under test (EUT)
1.1.1 General

(a) Trade name: Furuno

(b) Manufacturer: Furuno Electric Co., Ltd.
9-52, Ashihara-cho, Nishinomiya-city, Hyogo, 662-8580 Japan

(c) Model:

Transceiver for Marine Radar DRS12A-NXT

Name	Type	Serial number	Note
Radar Sensor	DRS12A-NXT	1001-2100-0001	--
Transceiver	RTR-125	--	--
Gear Box	RSB-137	--	Antenna rotation rate: 24/36/48 rpm
Radiator	XN12A	--	One (1) selectable
	XN13A	--	

Ancillary equipment

Name	Type	Serial number	Note
Multi Function Display	TZTL15F	100031-100173	--
Dummy load	4D376	R27200014	--
DC Power supply	PJA150F-24	L18400008XR	--
PC	PR73GEL2387AD11	8J075421H	--
HUB	LSW-TX-5EP(C3)	16481474283563	--

(d) FCC ID: ADB9ZWRTR125

(e) Primary function: Ship radar station operating in the band 9300–9500 MHz

(f) Frequency range: Fixed frequency, X-band (9380 – 9440 MHz)

(g) Type of emission: P0N/Q0N
(Emission designator)

(h) Occupied bandwidth:

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2
Occupied bandwidth (MHz)	ch1 (P0N)	60.5	52.3	43.1	29.3	18.3	11.0	9.2	8.3	9.2
	ch2 (P0N)	60.5	52.3	40.3	30.3	19.3	11.9	8.3	8.3	8.3
	ch3 (P0N)	59.6	53.2	42.2	31.2	20.2	12.8	9.2	9.2	9.2
	ch1 (Q0N)	18.3	18.3	14.7	9.2	7.3	6.4	6.4	4.6	4.6
	ch2 (Q0N)	18.3	18.3	15.6	9.2	7.3	6.4	6.4	4.6	4.6
	ch3 (Q0N)	18.3	18.3	15.6	9.2	8.3	6.4	6.4	4.6	4.6

Note: measured data

(i) Size and mass: Radar Sensor: 1265 mm × 445 mm (H), 21.0 kg (*1)
Radar Sensor: 1805 mm × 445 mm (H), 23.0 kg (*2)
(*1) with Radiator XN12A installed.
(*2) with Radiator XN13A installed.

(j) Power supply: 24 VDC

1.1.2 Transceiver module

Type: RTR-125 (Contained in Radar Sensor)

1.1.2.1 Transmitter

(a) Assignable frequency band: Between 9300 and 9500 MHz (CFR Title 47 Sections: 80.375 (d)-(1))

(b) Type of RF generator:

- Type: Solid-state device (no magnetron)
- Peak output power: 100 W nominal

(c) Fundamental frequency:

ch1: P0N 9380 MHz/ Q0N 9400 MHz
ch2: P0N 9400 MHz/ Q0N 9420 MHz
ch3: P0N 9420 MHz/ Q0N 9440 MHz

(d) Pulse characteristics:

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length (μs) P0N/Q0N	0.04/ 5.0	0.08/ 5.0	0.15/ 7.5	0.3/ 11	0.5/ 13	0.8/ 15	1.2/ 18	1.2/ 48	1.2/ 48
PRF(Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

1.1.2.2 Receiver

(a) Passband

RF Stage: 300 MHz
IF Stage: 50 MHz

(b) Intermediate Frequency: P0N 83.75 MHz
Q0N 103.75 MHz

(c) Gain (overall): Approximately 40 dB

(d) Overall Noise Figure: 4 dB (typical)

(e) Video Output Voltage: Not available

(f) Features Provided: Anti-clutter Sea, Anti-clutter Rain

(g) If receiver is tunable, describe method for adjusting frequency: Phase locked loop

1.1.3 Antenna and Scanner

(a) Antenna specifications

Antenna model		XN12A	XN13A
Length (mm)		1252	1791
Rotation diameter (mm)		1400	1940
Transmission frequency		ch1: P0N 9380MHz / Q0N 9400MHz	
		ch2: P0N 9400MHz / Q0N 9420MHz	
		ch3: P0N 9420MHz / Q0N 9440MHz	
Horizontal beam width (-3 dB)		1.9°	1.35°
Vertical beam width (-3 dB)		22°	22°
Side lobe (max.)	Less than ±20°	-24 dB	-28 dB
	Outside ±20°	-30 dB	-32 dB
Gain		28.0 dBi	29.5 dBi
Radiator		Slot array	
Polarization		Horizontal	
Type of beam		Vertical fan	

(b) Antenna Rotation ON-OFF Switch: Not provided

(c) Scanning (rotating or oscillating): Rotating over 360° continuously clockwise

(d) Antenna Rotation Rate: 24/36/48 rpm

(e) Sector Scan: Provided

(f) Rated Loss of Transmission Line per 100 Feet: Negligible (Transmission path is only in Radar Sensor.)

1.1.4 Operational Features

(a) Is positive means provided to indicate whether or not the overall operation of the equipment is such that it may be relied upon to provide effective operation in accordance with its primary function:
Yes (Hardware alarms)

(b) Is the equipment for continuous operation: Yes

(c) Is provision made for operation with shore based radar beacons (RACONS): Yes (RACONS)

1.1.5 Construction Features

(a) Does equipment embody replacement units with chassis type assembly: Yes

(b) Are fuse alarms provided: No

(c) State units that are weatherproof: Radar Sensor (IEC 60529 – IP56)

(d) If all units are not housed in a single container, indicate number and give description of individual units:
See Clause 1.1.1 (c) of this report.

(e) Approximate space required for installation excluding Radar Sensor: Not applicable

1.2 Observation and comments

None.

2 Test Results Summary

Clause number of this report	CFR Title 47 Sections	Item	Result	Test engineer
3.1	2.1046 (a), 80.215	RF Power Output	Passed.	K. Kawai
3.2	2.201, 2.1047 (d)	Modulation Characteristics	Passed.	K. Kawai
3.3	2.1055 (a)(2),(d)(1),(d)(3), 80.209 (b)	Frequency Stability –temperature & voltage	Passed.	K. Kawai
3.4	2.202 (a), 2.1049 (c)(1), 80.209 (b), 80.211 (f)	Occupied Bandwidth	Passed.	K. Kawai
3.5	2.1051, 80.211 (f), 80.273	Spurious Emissions at Antenna Terminals	Passed.	K. Kawai
3.6	2.1053, 80.211 (f)	Field Strength of Spurious Radiation	Passed.	A. Sakai and A. Takagi

3 Test Results

3.1 RF Power Output (CFR Title 47 Sections: 2.1046 (a) and 80.215)

3.1.1 Test conditions:

For all TX (S0/S1/S2/M1/M2/M3/L1/L2) pulses, the transmitter output power was measured with a non-reflective load and a directional coupler as a substitute for Radiator.

3.1.2 Test setup:

See Clause 4.

3.1.3 Test Results:

ch1, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.007	0.013	0.024	0.049	0.082	0.072	0.108	0.074	0.058
Pulse length *T* (μs) (50% points)	0.041	0.073	0.146	0.295	0.498	0.797	1.197	1.197	1.197
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	83.6	86.0	82.1	82.7	82.8	81.6	81.8	88.3	88.6

ch1, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.886	0.894	1.347	2.016	2.397	1.524	1.839	3.214	2.527
Pulse length *T* (μs) (50% points)	4.988	4.983	7.480	10.984	12.994	14.996	17.990	48.010	48.030
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	88.8	89.7	90.0	91.8	92.2	92.4	93.0	95.6	95.7

ch2, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.007	0.013	0.023	0.047	0.080	0.070	0.105	0.072	0.056
Pulse length *T* (μs) (50% points)	0.040	0.072	0.146	0.295	0.498	0.797	1.196	1.197	1.197
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	84.5	86.6	78.9	79.9	80.2	79.5	79.8	86.2	85.5

ch2, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.911	0.894	1.338	1.997	2.387	1.524	1.839	3.233	2.545
Pulse length *T* (μs) (50% points)	4.990	4.985	7.481	10.989	12.995	15.012	18.006	47.990	47.990
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	91.3	89.6	89.4	90.9	91.9	92.3	92.9	96.2	96.4

(*1) P_p (W) = (P_m (W) / (T (μs) × PRF (Hz))) × 1000000

ch3, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.007	0.013	0.023	0.047	0.079	0.068	0.102	0.071	0.055
Pulse length *T* (μs) (50% points)	0.041	0.073	0.146	0.295	0.498	0.796	1.196	1.197	1.197
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	84.8	87.2	80.1	79.4	79.0	77.4	77.6	85.0	84.1

ch3, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Transmission mean power Pm (W)	0.921	0.917	1.347	2.007	2.397	1.533	1.839	3.214	2.555
Pulse length *T* (μs) (50% points)	4.979	4.982	7.476	10.976	12.984	14.982	17.980	47.980	47.980
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550
Transmission pulse power Pp (W) (*1)	92.5	92.0	90.1	91.4	92.3	93.0	93.0	95.7	96.8

(*1) P_p (W) = (P_m (W) / (T (μs) × PRF (Hz))) × 1000000

Environmental conditions observed: On 19 June 2019, 24°C to 24°C, 46%RH to 46%RH
On 20 June 2019, 24°C to 24°C, 53%RH to 53%RH
On 21 June 2019, 23°C to 23°C, 59%RH to 59%RH
On 5 July 2019, 23°C to 23°C, 67%RH to 67%RH

Power supply voltage measured: 24 VAC to 24 VAC

3.2 Modulation Characteristics (CFR Title 47 Sections: 2.201, 2.1047 (d))

3.2.1 Test Conditions:

The RF envelope of the magnetron output pulse was measured with an envelope detector and an oscilloscope. Each pulse spectrum was measured with a spectrum analyzer.

3.2.2 Test setup:

See Clause 4.

3.2.3 Test Results:

ch1, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	0.041	0.073	0.146	0.295	0.498	0.797	1.197	1.197	1.197
Rise time t_r (μs) (10 to 90 % amplitude)	0.031	0.032	0.030	0.030	0.029	0.028	0.026	0.027	0.028
Fall time t_f (μs) (90 to 10 % amplitude)	0.025	0.030	0.028	0.028	0.028	0.027	0.028	0.028	0.027
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

ch1, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	4.988	4.983	7.480	10.984	12.994	14.996	17.990	48.010	48.030
Rise time t_r (μs) (10 to 90 % amplitude)	0.332	0.284	0.248	0.316	0.376	0.420	0.512	1.360	1.360
Fall time t_f (μs) (90 to 10 % amplitude)	0.124	0.120	0.200	0.302	0.356	0.408	0.494	1.300	1.300
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

ch2, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	0.040	0.072	0.146	0.295	0.498	0.797	1.196	1.197	1.197
Rise time t_r (μs) (10 to 90 % amplitude)	0.031	0.032	0.028	0.029	0.028	0.027	0.026	0.028	0.028
Fall time t_f (μs) (90 to 10 % amplitude)	0.025	0.030	0.028	0.029	0.028	0.028	0.028	0.028	0.028
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

ch2, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	4.990	4.985	7.481	10.989	12.995	15.012	18.006	47.990	47.990
Rise time t_r (μs) (10 to 90 % amplitude)	0.328	0.300	0.250	0.314	0.370	0.421	0.511	1.356	1.340
Fall time t_f (μs) (90 to 10 % amplitude)	0.128	0.123	0.201	0.304	0.361	0.413	0.497	1.316	1.320
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

ch3, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	0.041	0.073	0.146	0.295	0.498	0.796	1.196	1.197	1.197
Rise time t_r (μs) (10 to 90 % amplitude)	0.024	0.025	0.022	0.021	0.020	0.020	0.019	0.020	0.020
Fall time t_f (μs) (90 to 10 % amplitude)	0.026	0.033	0.030	0.030	0.030	0.030	0.030	0.029	0.030
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

ch3, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Pulse length T (μs) (-3 dB points)	4.979	4.982	7.476	10.976	12.984	14.982	17.980	47.980	47.980
Rise time t_r (μs) (10 to 90 % amplitude)	0.328	0.286	0.246	0.316	0.372	0.420	0.508	1.360	1.340
Fall time t_f (μs) (90 to 10 % amplitude)	0.124	0.124	0.198	0.298	0.357	0.412	0.496	1.320	1.320
Pulse Repetition Frequency (Hz)	2000	2000	2000	2000	2000	1100	1100	700	550

Measured Plots: See Clause 7.

Environmental conditions observed: On 19 June 2019, 24°C to 24°C, 46%RH to 46%RH
On 20 June 2019, 24°C to 24°C, 53%RH to 53%RH
On 21 June 2019, 23°C to 23°C, 59%RH to 59%RH

Power supply voltage measured: 24 VAC to 24 VAC

3.3 Frequency Stability –temperature & voltage
(CFR Title 47 Sections: 2.1055 (a)(2)/(d)(1)/(d)(3), 80.209(b))

3.3.1 Test Conditions:

(1) Radar transmitter settings: All TX (S0/S1/S2/M1/M2/M3/L1/L2) pulses

(2) Ambient temperature settings: -20°C to +50°C (10°C interval)

(3) Power supply voltage settings: 85/100/115% of nominal voltage

Radar Sensor: 24 VDC V_L: 20.4 VDC / V_{nom}: 24 VDC / V_H: 27.6 VDC

3.3.2 Test setup:

See Clause 4.

3.3.3 Frequency Tolerance Limits (CFR Title 47 Sections: 2.1055 (a)(2)/(d)(1)/(d)(3),80.209(b)):

ch1, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	36.67	20.58	10.28	5.08	3.01	1.88	1.25	1.25	1.25
Upper limit (MHz) (*2)	9463.3	9479.4	9489.7	9494.9	9497.0	9498.1	9498.7	9498.7	9498.7
Lower limit (MHz) (*2)	9336.7	9320.6	9310.3	9305.1	9303.0	9301.9	9301.3	9301.3	9301.3

ch1, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	0.30	0.30	0.20	0.14	0.12	0.10	0.08	0.03	0.03
Upper limit (MHz) (*2)	9499.7	9499.7	9499.8	9499.9	9499.9	9499.9	9499.9	9500.0	9500.0
Lower limit (MHz) (*2)	9300.3	9300.3	9300.2	9300.1	9300.1	9300.1	9300.1	9300.0	9300.0

ch2, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	37.09	20.71	10.28	5.08	3.01	1.88	1.25	1.25	1.25
Upper limit (MHz) (*2)	9462.9	9479.3	9489.7	9494.9	9497.0	9498.1	9498.7	9498.7	9498.7
Lower limit (MHz) (*2)	9337.1	9320.7	9310.3	9305.1	9303.0	9301.9	9301.3	9301.3	9301.3

ch2, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	0.30	0.30	0.20	0.14	0.12	0.10	0.08	0.03	0.03
Upper limit (MHz) (*2)	9499.7	9499.7	9499.8	9499.9	9499.9	9499.9	9499.9	9500.0	9500.0
Lower limit (MHz) (*2)	9300.3	9300.3	9300.2	9300.1	9300.1	9300.1	9300.1	9300.0	9300.0

(*1) Guard Band is specified to be equal to 1.5/T MHz, where "T" is the pulse length in microseconds.
(CFR Title 47 Sections: 80.209 (b))

(*2) Upper limit frequency, f(U) =9500 -1.5/T
Lower limit frequency, f(L) = 9300 +1.5/T

ch3, P0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	36.67	20.56	10.31	5.09	3.01	1.88	1.25	1.25	1.25
Upper limit (MHz) (*2)	9463.3	9479.4	9489.7	9494.9	9497.0	9498.1	9498.7	9498.7	9498.7
Lower limit (MHz) (*2)	9336.7	9320.6	9310.3	9305.1	9303.0	9301.9	9301.3	9301.3	9301.3

ch3, Q0N

Pulse type	S0	S1	S2	M1	M2	M3	L1	L2	L2
Guard Band f(1.5/T) (MHz) (*1)	0.30	0.30	0.20	0.14	0.12	0.10	0.08	0.03	0.03
Upper limit (MHz) (*2)	9499.7	9499.7	9499.8	9499.9	9499.9	9499.9	9499.9	9500.0	9500.0
Lower limit (MHz) (*2)	9300.3	9300.3	9300.2	9300.1	9300.1	9300.1	9300.1	9300.0	9300.0

(*1) Guard Band is specified to be equal to 1.5/T MHz, where "T" is the pulse length in microseconds.
(CFR Title 47 Sections: 80.209 (b))
(*2) Upper limit frequency, f(U) =9500 -1.5/T
Lower limit frequency, f(L) = 9300 +1.5/T

3.3.4 Test Results:

Complied.

(1) Temperature test at the rated supply voltage of 24 VDC:

ch1, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9381.3	9381.0	9380.2	9380.1	9379.9	9379.9	9379.8	9379.9	9379.9	Complied.
	-10°C	9381.7	9380.0	9379.7	9379.9	9379.9	9379.9	9379.9	9379.9	9379.8	Complied.
	0°C	9380.5	9380.1	9379.7	9379.5	9379.8	9379.9	9379.9	9379.8	9379.8	Complied.
	+10°C	9380.1	9379.6	9379.8	9379.7	9379.7	9379.8	9379.8	9379.8	9379.8	Complied.
	+20°C	9381.0	9379.8	9379.5	9379.8	9379.8	9379.8	9379.9	9379.8	9379.8	Complied.
	+30°C	9380.3	9379.5	9379.5	9379.9	9379.8	9379.9	9379.9	9379.8	9379.8	Complied.
	+40°C	9379.6	9379.7	9379.7	9379.6	9379.7	9379.8	9379.7	9379.7	9379.8	Complied.
	+50°C	9380.3	9379.7	9379.4	9379.6	9379.8	9379.8	9379.8	9379.8	9379.8	Complied.

ch1, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9399.7	9400.0	9400.0	9399.9	9400.0	9400.0	9400.0	9400.0	9400.0	Complied.
	-10°C	9400.1	9399.9	9400.1	9400.0	9400.0	9400.0	9400.0	9400.0	9400.0	Complied.
	0°C	9399.7	9399.3	9399.5	9399.9	9399.7	9400.0	9399.8	9399.8	9399.7	Complied.
	+10°C	9399.4	9399.6	9399.5	9399.4	9399.5	9399.7	9399.8	9399.8	9399.9	Complied.
	+20°C	9399.8	9399.5	9399.5	9399.7	9399.7	9399.7	9399.6	9399.8	9399.7	Complied.
	+30°C	9399.9	9399.6	9399.4	9399.3	9399.7	9399.7	9399.7	9399.7	9399.8	Complied.
	+40°C	9399.7	9399.7	9399.7	9399.8	9399.6	9399.8	9399.7	9399.8	9399.8	Complied.
	+50°C	9399.3	9399.3	9399.3	9399.8	9399.9	9399.8	9399.9	9399.9	9399.9	Complied.

ch2, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9401.0	9400.2	9400.1	9399.8	9399.9	9400.0	9400.0	9400.0	9400.0	Complied.
	-10°C	9399.5	9400.2	9399.9	9400.0	9400.0	9400.1	9400.0	9400.0	9400.0	Complied.
	0°C	9399.5	9399.4	9400.0	9399.8	9400.1	9399.9	9400.2	9400.0	9400.0	Complied.
	+10°C	9399.7	9400.0	9399.4	9399.8	9399.9	9400.0	9400.0	9400.0	9400.0	Complied.
	+20°C	9399.6	9399.7	9399.9	9399.9	9399.9	9399.9	9400.0	9400.0	9400.0	Complied.
	+30°C	9401.1	9399.4	9399.9	9399.7	9399.9	9399.9	9400.0	9400.0	9400.0	Complied.
	+40°C	9400.0	9399.4	9399.4	9399.7	9399.8	9400.0	9400.0	9400.0	9400.0	Complied.
	+50°C	9399.5	9399.6	9399.9	9399.7	9399.8	9399.9	9399.9	9399.9	9400.0	Complied.

ch2, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9420.2	9420.1	9420.0	9420.1	9420.2	9420.1	9420.1	9420.1	9420.2	Complied.
	-10°C	9419.8	9419.8	9420.1	9420.1	9420.1	9420.1	9420.1	9420.1	9420.1	Complied.
	0°C	9419.3	9419.5	9419.5	9420.0	9419.9	9419.9	9419.9	9419.9	9419.9	Complied.
	+10°C	9419.7	9419.3	9419.5	9419.6	9419.8	9419.8	9419.8	9419.9	9419.8	Complied.
	+20°C	9419.8	9419.6	9419.4	9419.9	9419.9	9420.0	9420.0	9420.0	9419.9	Complied.
	+30°C	9419.6	9419.3	9420.0	9419.7	9419.7	9419.7	9419.9	9419.8	9419.9	Complied.
	+40°C	9419.7	9419.5	9419.7	9419.9	9419.8	9419.8	9419.8	9419.9	9419.9	Complied.
	+50°C	9419.5	9419.5	9419.8	9419.9	9420.0	9420.0	9419.9	9420.0	9420.0	Complied.

ch3, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9418.8	9419.7	9420.1	9420.0	9420.0	9420.0	9419.9	9420.0	9420.0	Complied.
	-10°C	9420.2	9419.7	9419.9	9419.9	9420.0	9420.0	9420.0	9420.0	9419.9	Complied.
	0°C	9419.5	9419.7	9419.9	9420.0	9419.8	9420.0	9419.9	9419.9	9419.9	Complied.
	+10°C	9418.7	9419.4	9419.9	9419.7	9419.9	9419.9	9420.0	9420.0	9420.0	Complied.
	+20°C	9419.4	9419.3	9419.4	9419.9	9419.9	9420.0	9419.9	9419.9	9419.9	Complied.
	+30°C	9419.8	9418.5	9419.4	9419.7	9419.7	9419.8	9419.9	9419.9	9420.0	Complied.
	+40°C	9419.1	9419.1	9419.5	9420.0	9419.8	9419.9	9419.9	9419.9	9419.9	Complied.
	+50°C	9419.3	9419.5	9419.7	9419.9	9420.0	9419.8	9419.9	9419.9	9419.9	Complied.

ch3, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	-20°C	9439.8	9440.1	9440.0	9440.1	9440.1	9440.1	9440.0	9440.0	9440.0	Complied.
	-10°C	9439.9	9439.9	9440.0	9440.1	9440.0	9440.0	9440.1	9440.0	9440.0	Complied.
	0°C	9439.2	9439.7	9439.8	9440.0	9439.9	9440.0	9440.0	9440.0	9440.0	Complied.
	+10°C	9439.7	9439.7	9439.7	9439.9	9439.8	9439.8	9439.9	9439.9	9439.9	Complied.
	+20°C	9439.5	9439.5	9440.2	9439.7	9440.0	9439.9	9439.8	9440.0	9440.0	Complied.
	+30°C	9439.8	9439.5	9439.1	9439.7	9439.6	9439.8	9439.8	9439.8	9439.9	Complied.
	+40°C	9439.5	9439.7	9439.8	9439.9	9439.9	9439.9	9440.0	9440.0	9439.9	Complied.
	+50°C	9439.5	9439.7	9439.7	9439.9	9439.9	9440.0	9439.9	9440.0	9439.9	Complied.

(2) Voltage variation test at the temperature of +20°C:

ch1, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9379.3	9379.9	9379.7	9379.6	9379.9	9379.8	9379.8	9379.8	9379.8	Complied.
	V_{nom}	9381.0	9379.8	9379.5	9379.8	9379.8	9379.8	9379.9	9379.8	9379.8	Complied.
	V_H	9379.7	9379.3	9379.5	9379.8	9379.7	9379.8	9379.9	9379.9	9379.8	Complied.

ch1, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9399.9	9399.5	9399.0	9399.6	9399.7	9399.7	9399.8	9399.8	9399.8	Complied.
	V_{nom}	9399.8	9399.5	9399.5	9399.7	9399.7	9399.7	9399.6	9399.8	9399.7	Complied.
	V_H	9399.5	9399.5	9399.6	9400.0	9399.6	9399.6	9399.8	9399.9	9400.0	Complied.

ch2, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9399.9	9399.4	9399.7	9399.8	9400.0	9400.0	9400.0	9400.0	9400.0	Complied.
	V_{nom}	9399.6	9399.7	9399.9	9399.9	9399.9	9399.9	9400.0	9400.0	9400.0	Complied.
	V_H	9399.4	9399.7	9399.8	9400.0	9399.9	9399.8	9400.0	9400.0	9399.9	Complied.

ch2, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9420.1	9419.3	9419.6	9419.9	9420.0	9419.9	9420.0	9419.9	9420.0	Complied.
	V_{nom}	9419.8	9419.6	9419.4	9419.9	9419.9	9420.0	9420.0	9420.0	9419.9	Complied.
	V_H	9419.5	9419.4	9419.7	9419.7	9419.8	9419.8	9419.9	9419.9	9419.9	Complied.

ch3, P0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9419.1	9419.5	9419.6	9419.8	9419.8	9419.9	9420.0	9420.0	9419.9	Complied.
	V_{nom}	9419.4	9419.3	9419.4	9419.9	9419.9	9420.0	9419.9	9419.9	9419.9	Complied.
	V_H	9419.4	9419.0	9419.6	9419.8	9419.8	9419.9	9419.9	9419.9	9419.9	Complied.

ch3, Q0N

Pulse type		S0	S1	S2	M1	M2	M3	L1	L2	L2	Result
Frequency at maximum emission (MHz)	V_L	9439.5	9439.3	9439.6	9439.8	9439.7	9439.8	9440.0	9440.0	9440.0	Complied.
	V_{nom}	9439.5	9439.5	9440.2	9439.7	9440.0	9439.9	9439.8	9440.0	9440.0	Complied.
	V_H	9440.2	9440.2	9440.0	9440.0	9439.9	9440.0	9439.8	9439.8	9439.9	Complied.

Environmental conditions observed: On 23 June 2019, 24°C to 24°C, 53%RH to 53%RH
On 24 June 2019, 23°C to 24°C, 52%RH to 46%RH
On 25 June 2019, 23°C to 24°C, 52%RH to 60%RH

Power supply voltage measured: 24 VDC to 24 VDC

3.4 Occupied Bandwidth
(CFR Title 47 Sections: 2.202 (a), 2.1049 (c)(1), 80.209 (b), 80.211 (f))

3.4.1 Test conditions:

For all TX (S0/S1/S2/M1/M2/M3/L1/L2) pulses, the transmitter output power was measured with a non-reflective load and a directional coupler as a substitute for Radiator.

3.4.2 Test setup:

See Clause 4.

3.4.3 Emission Limits (CFR Title 47 Sections: 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
50 to 100 % (of the authorized bandwidth) (*2)	At least 25
100 to 250 % (of the authorized bandwidth) (*2)	At least 35
more than 250 % (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts) = -13 dBm

(*1) Assigned frequency (center frequency) = 9410 MHz (for X-band radars)
(*2) Authorized band width = 110 MHz (for X-band radars)

3.4.4 Test Results:

Complied.

Spectrum plots: See Clause 7.

Environmental conditions observed: On 27 June 2019, 23°C to 24°C, 59%RH to 68%RH
On 28 June 2019, 24°C to 24°C, 60%RH to 60%RH

Power supply voltage measured: 24 VDC to 24 VDC

3.5 Spurious Emissions at Antenna Port (CFR Title 47 Sections: 2.1051, 80.211 (f), 80.273 and ITU-R SM.329-12)

3.5.1 Test Conditions:

(a) For S0 pulse, the transmitter output power was measured with a waveguide converter as a substitute for Radiator. (*1)

(*1) Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B–40 bandwidth. (IEC 62388 Ed.2/ Annex B.4.2 part)

(b) Spurious measurement range for X-band radar: 4.59 GHz to 40 GHz

Lower measurement band	Upper measurement band
From 4.59 GHz (*1) to the lower OoB boundary	From the upper OoB boundary to 40 GHz

(*1) 0.7 times of the waveguide cut-off frequency for WRJ-10 (ITU-R SM.329-12, Section 2.5)

3.5.2 Test setup:

See Clause 4.

3.5.3 Emission Limits (CFR Title 47 Sections: 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
More than 250% (*3) (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts) = -13 dBm

(*1) Assigned frequency (center frequency) = 9380, 9400, 9420 and 9440 MHz (for X-band radars)
(*2) Authorized bandwidth = 110 MHz (for X-band radars)
(*3) Spurious measurement range for X-band radar: 4.59 GHz to 40 GHz

3.5.4 Harmonics Frequencies:

f_0 (GHz)	$1/2f_0$	$2f_0$	$3f_0$	$4f_0$
9.380	4.690	18.760	28.140	37.520
9.400	4.700	18.800	28.200	37.600
9.420	4.710	18.840	28.260	37.680
9.440	4.720	18.880	28.320	37.760

3.5.5 Test Results:

Complied.

Spurious emission frequency and levels measured of which margins were below 20 dB were listed in the following table.

Frequency (GHz)	Level (dBm)	Limit (dBm)	Margin (dB)
28.192	-24.87	-13.00	11.87
28.267	-32.03	-13.00	19.03

Environmental conditions observed: On 1 July 2019, 26°C to 24°C, 69%RH to 60%RH
On 2 July 2019, 24°C to 24°C, 60%RH to 60%RH

Power supply voltage measured: 24 VDC to 24 VDC

3.6 Field Strength of Spurious Radiation (CFR Title 47 Sections: 2.1053, 80.211 (f) and ITU-R SM.329-12)

3.6.1 Test Conditions:

(a) For S0 pulse, the transmitter output power was measured with the non-reflective load as a substitute for Radiator. (*1)

(*1) Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B–40 bandwidth. (IEC 62388 Ed.2/ Annex B.4.2 part)

(b) Spurious measurement range for X-Band RADAR: 4.59 GHz to 40 GHz

Lower measurement band	Upper measurement band
From 4.59 GHz (*1) to the lower OoB boundary	From the upper OoB boundary to 40 GHz

(*1) 0.7 times of the waveguide cut-off frequency for WRJ-10 (ITU-R SM.329-12, Section 2.5)

(c) Antenna port was terminated with dummy load.

3.6.2 Test Site: LIC EMC Center, Semi-anechoic chamber

3.6.3 Distance between the Radar and Measuring Antenna: 3 m

3.6.4 Test setup:

See Clause 4.
The GRP (Ground reference plane, metal floor) between the EUT and the measuring (receiving) antenna was lined with the radio absorbers (3.0 m × 2.4 m × 0.3 m) to reduce the influences of the reflections of the RF waves from the floor.

Measuring (receiving) the antenna height and polarization:

(a) Antenna height: EUT center (1.95 m)

(b) Antenna polarization: vertical and horizontal.

EUT height: 1.5 m

3.6.5 Field Strength Limits (CFR Title 47 Sections: 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
More than 250% (*3) (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts) = -13 dBm

(*1) Assigned frequency (center frequency) = 9410 MHz (for X-band radars)
(*2) Authorized bandwidth = 110 MHz (for X-band radars)
(*3) Spurious measurement range for X-band radar: 4.59 GHz to 40 GHz

3.6.6 Harmonics Frequencies:

f_0 (GHz)	1/2f_0	2f_0	3f_0	4f_0
9.410	4.705	18.820	28.23	37.64

3.6.7 Test Results:

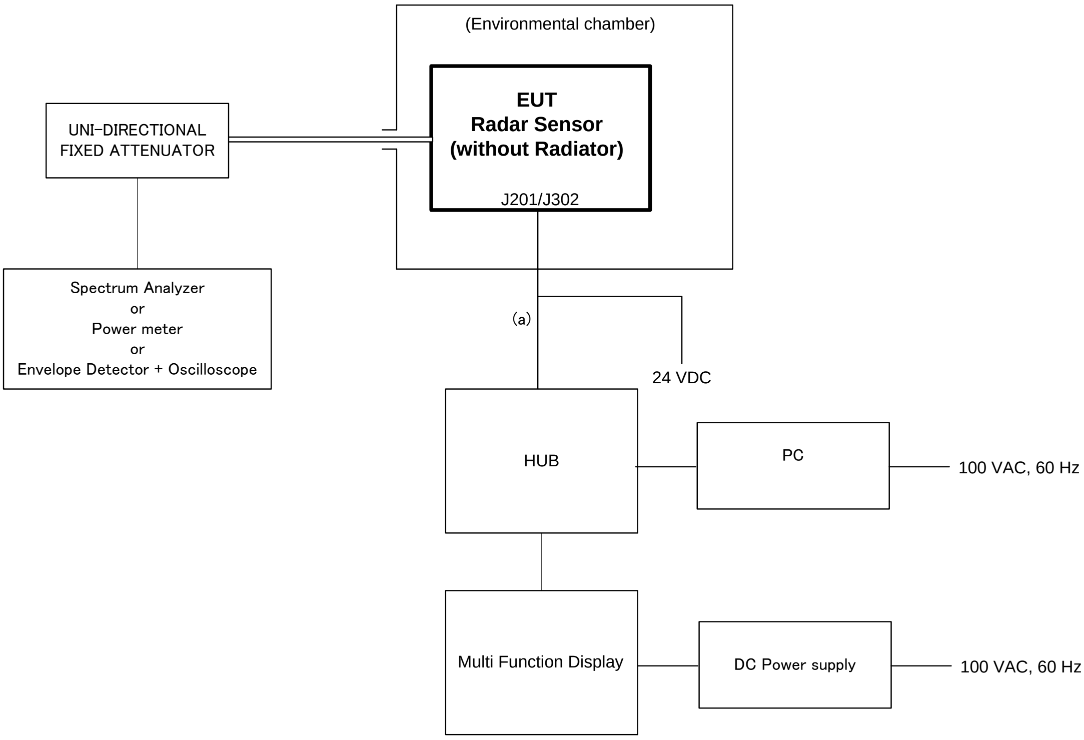
Complied.
Spurious emission levels measured were found to be attenuated more than 20 dB below the limits.

Environmental conditions observed: On 29 July 2019, 20°C to 20°C, 60%RH to 60%RH
On 30 July 2019, 20°C to 20°C, 56%RH to 56%RH
On 31 July 2019, 20°C to 20°C, 56%RH to 56%RH

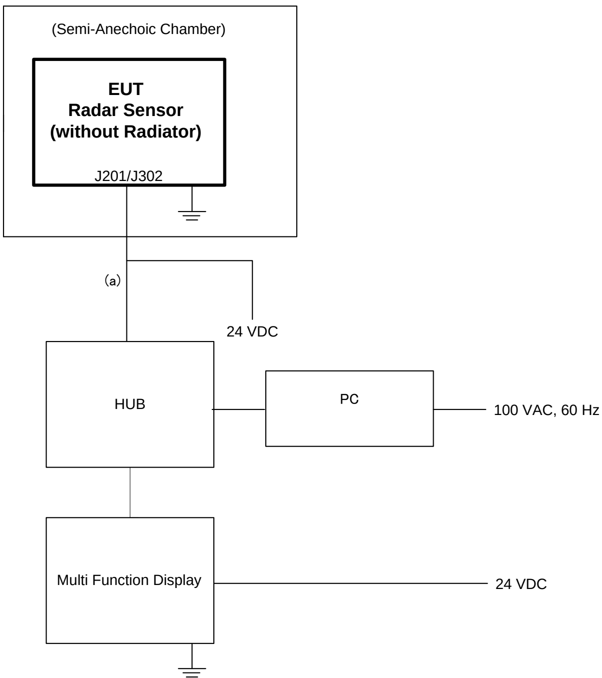
Power supply voltage measured: 24 VDC to 24 VDC

4 Test Setup for Measurements

4.1 Test Setup for Clause 3.1, 3.2, 3.3, 3.4 and 3.5



4.2 Test Setup for Clause 3.6



Cable designations

No.	Category (*)	Cable name	Type	Length (m)	Number of cables	Cable Shielded
a	P/S	Antenna cable	FRU-2P5S-FF-20M	20	1	Yes

(*) P – Power cable, S – Signal/control cable.

5 Measuring Equipment List

Measuring/Test instruments have been appropriately calibrated/maintained according to the LIC programs/ procedures and ISO/IEC 17025. Measuring/Test instruments used for the tests are listed below.

(1) For Clause 3.1 RF Power Output

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1254	UNI-DIRECTIONAL FIXED ATTENUATOR	50HF-020-50/18 N	20190304	JFW	12 March 2019	1 year
HT552	Power meter	E4418B	GB43315050	Agilent	28 May 2019	1 year
HT325	Power sensor	8481A	2702A70235	Agilent	2 July 2019	1 year
HT432	DC power supply	PAN55-20	AK003307	Kikusui	--	--
HT415	Climatic chamber (Small)	PL-4KP	14004204	Espec	24 September 2018	1 year
HT724	Paperless recorder/ Dual communication logger	FX106-4-1	S5JA01450	Yokogawa	--	--
HT831	Digital multimeter	115	15540244	Fluke	16 May 2019	1 year

(2) For Clause 3.2 Modulation Characteristics

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1254	UNI-DIRECTIONAL FIXED ATTENUATOR	50HF-020-50/18 N	20190304	JFW	12 March 2019	1 year
RT213	Waveguide	WRJ-10	--	Furuno	19 July 2018	1 year
HT654	Attenuator	8494B	MY42148134	Agilent	21 February 2019	1 year
HT1223	Attenuator	8495B	MY42148137	Agilent	21 February 2019	1 year
HT1221	Crystal detector	423B	MY51342422	Agilent	18 March 2019	1 year
0808052	Frequency counter	MF2414C	6200769857	ANRITSU	20 July 2018	1 year
HT972	Oscilloscope	MSO4054B	C030483	TEKTRONIX	17 March 2019	1 year
HT432	DC power supply	PAN55-20	AK003307	Kikusui	--	--
HT831	Digital multimeter	115	15540244	Fluke	16 May 2019	1 year

(3) For Clause 3.3 Frequency Stability –temperature & voltage

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1254	UNI-DIRECTIONAL FIXED ATTENUATOR	50HF-020-50/18 N	20190304	JFW	12 March 2019	1 year
RT213	Waveguide	WRJ-10	--	Furuno	19 July 2018	1 year
HT654	Attenuator	8494B	MY42148134	Agilent	21 February 2019	1 year
HT1223	Attenuator	8495B	MY42148137	Agilent	21 February 2019	1 year
HT676	Spectrum analyzer	8564EC	4103A00440	Agilent	10 May 2019	1 year
HT415	Climatic chamber (Small)	PL-4KP	14004204	Espec	24 September 2018	1 year
HT724	Paperless recorder/ Dual communication logger	FX106-4-1	S5JA01450	Yokogawa	--	--
HT432	DC power supply	PAN55-20	AK003307	Kikusui	--	--
HT831	Digital multimeter	115	15540244	Fluke	16 May 2019	1 year

(4) For Clause 3.4 Occupied Bandwidth

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1254	UNI-DIRECTIONAL FIXED ATTENUATOR	50HF-020-50/18 N	20190304	JFW	12 March 2019	1 year
HT654	Attenuator	8494B	MY42148134	Agilent	21 February 2019	1 year
HT1223	Attenuator	8495B	MY42148137	Agilent	21 February 2019	1 year
HT676	Spectrum analyzer	8564EC	4103A00440	Agilent	10 May 2019	1 year
HT432	DC power supply	PAN55-20	AK003307	Kikusui	--	--
HT831	Digital multimeter	115	15540244	Fluke	16 May 2019	1 year

(5) For Clause 3.5 Spurious Emissions at Antenna Port

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1254	UNI-DIRECTIONAL FIXED ATTENUATOR	50HF-020-50/18 N	20190304	JFW	12 March 2019	1 year
--	Adapter	BL00-6254-00	--	Orient Microwave	Not applicable.	--
--	Adapter	PE9803	---	Pasternack	Not applicable.	--
--	Adapter	BL00-6256-00	--	Orient Microwave	Not applicable.	--
--	Adapter	PE9826	---	Pasternack	Not applicable.	--
--	Circulator	RC-3686H	1253 DSP	TDK	Not applicable.	--
HT676	Spectrum analyzer	8564EC	4103A00440	Agilent	10 May 2019	1 year
HT432	DC power supply	PAN55-20	AK003307	Kikusui	--	--
HT831	Digital multimeter	115	15540244	Fluke	16 May 2019	1 year
KB289	Coaxial cable	SF104A/11PC35/11PC35/5500MM	800048/4A	HUBER+ SUHNER	11 August 2018	1 year
KB181	Coaxial cable	SUCOFLEX 102A	1261/2A	HUBER+ SUHNER	11 August 2018	1 year

(6) For Clause 3.6 Field Strength of Spurious Radiation

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT779	Semi-anechoic chamber	10mSAC	90984	Tokin	SVSWR: 3 December 2016	3 years
HT744	Test software	EP5/RE	Ver.6.0.10	Toyo	--	--
HT745	EMI test receiver (20 Hz to 40 GHz)	ESU40	110243	Rohde & Schwarz	11 August 2018	1 year
HT758	Broadband horn antenna (1 GHz to 6 GHz)	9120B	522	Schwarzbeck	13 August 2018	1 year
HT1263	Pre-amp. (1 GHz to 6 GHz)	00-T1885	BBB1932270	Noiseken	8 May 2019	1 year
HT759	Double ridged horn antenna & amp. (6 GHz to 18 GHz)	HAP06-18W	00000065	Toyo	1 August 2018	1 year
HT761	Double rigged horn antenna & amp. (18 GHz to 26 GHz)	HAP18-26N	00000017	Toyo	15 August 2018	1 year
HT762	Double rigged horn antenna & amp. (26 GHz to 40 GHz)	HAP26-40N	00000010	Toyo	15 August 2018	1 year
HT866	Digital multimeter	115	19170029	Fluke	15 February 2019	1 year
HT781	DC power supply	PAN60-20A	QM003356	Kikusui	--	--

6 RF Envelope and Spectrum of the Output Pulse

ch1, P0N

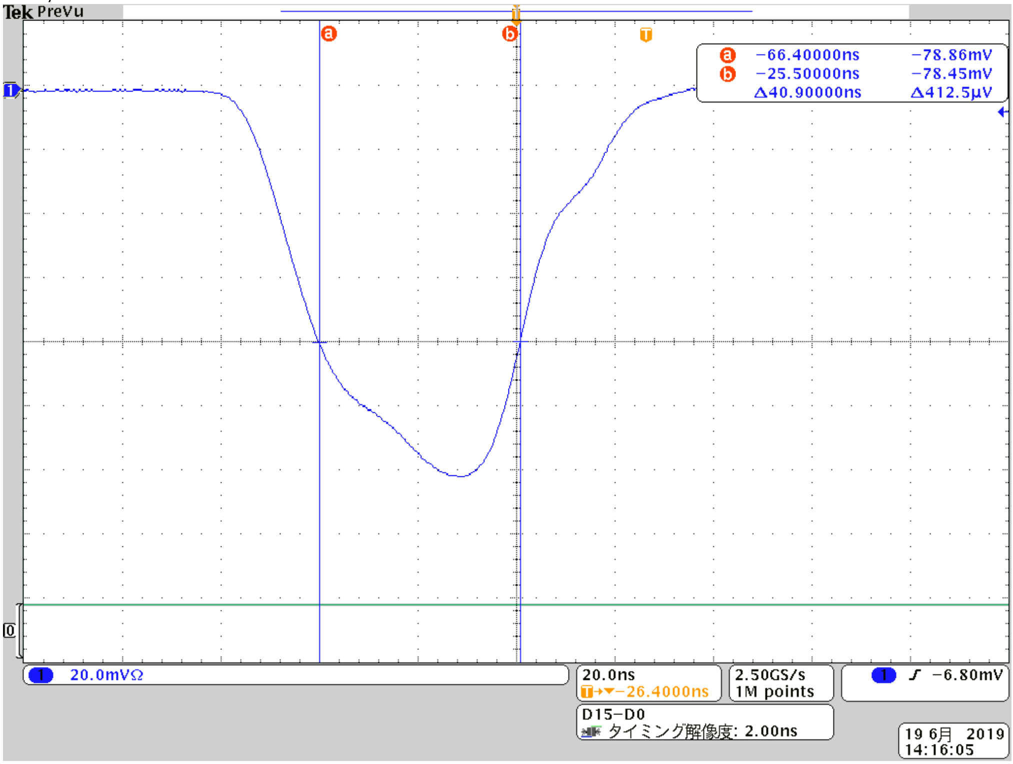


Fig. 6.1 ch1, P0N, S0 pulse envelope

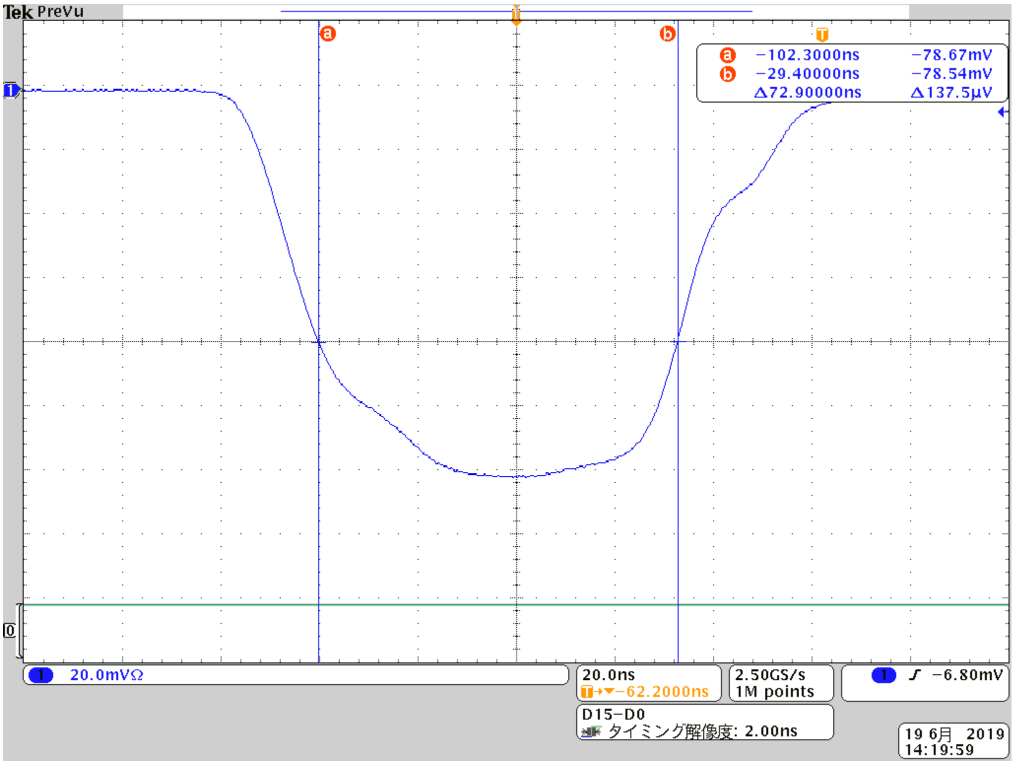


Fig. 6.2 ch1, P0N, S1 pulse envelope

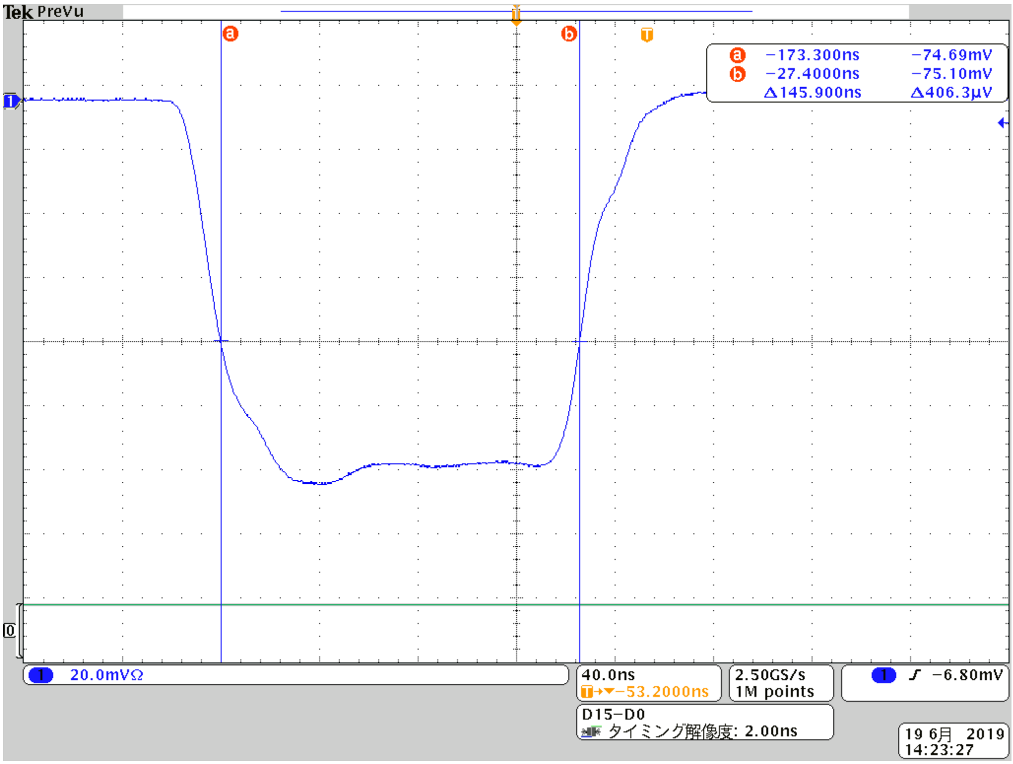


Fig. 6.3 ch1, P0N, S2 pulse envelope

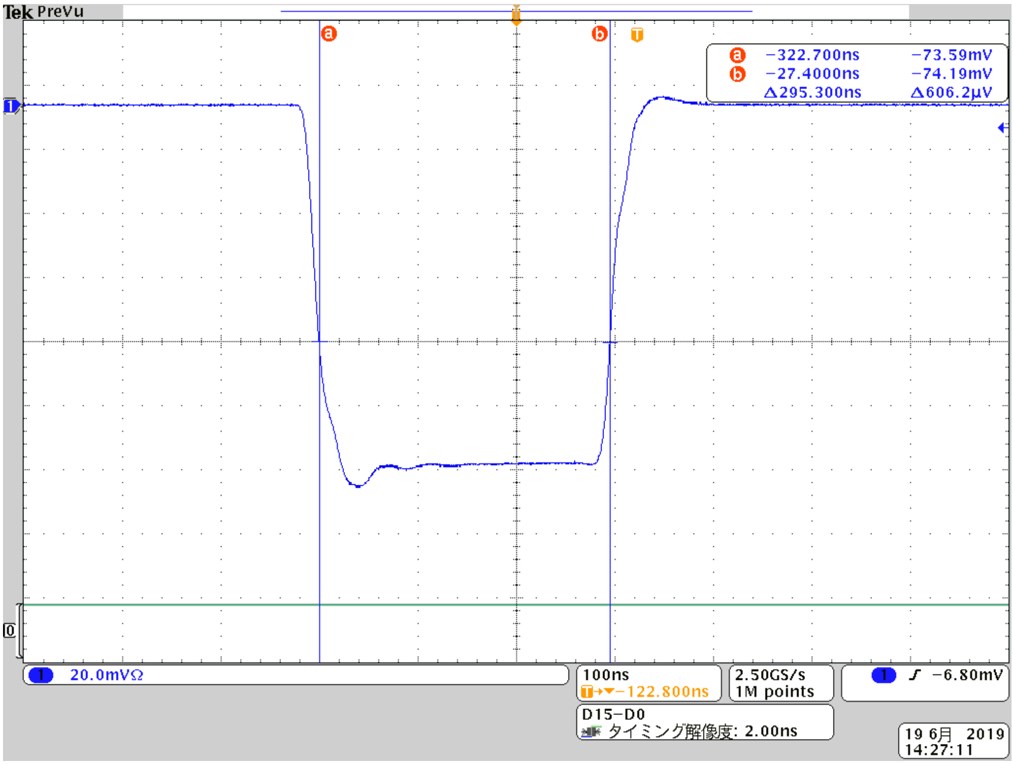


Fig. 6.4 ch1, P0N, M1 pulse envelope

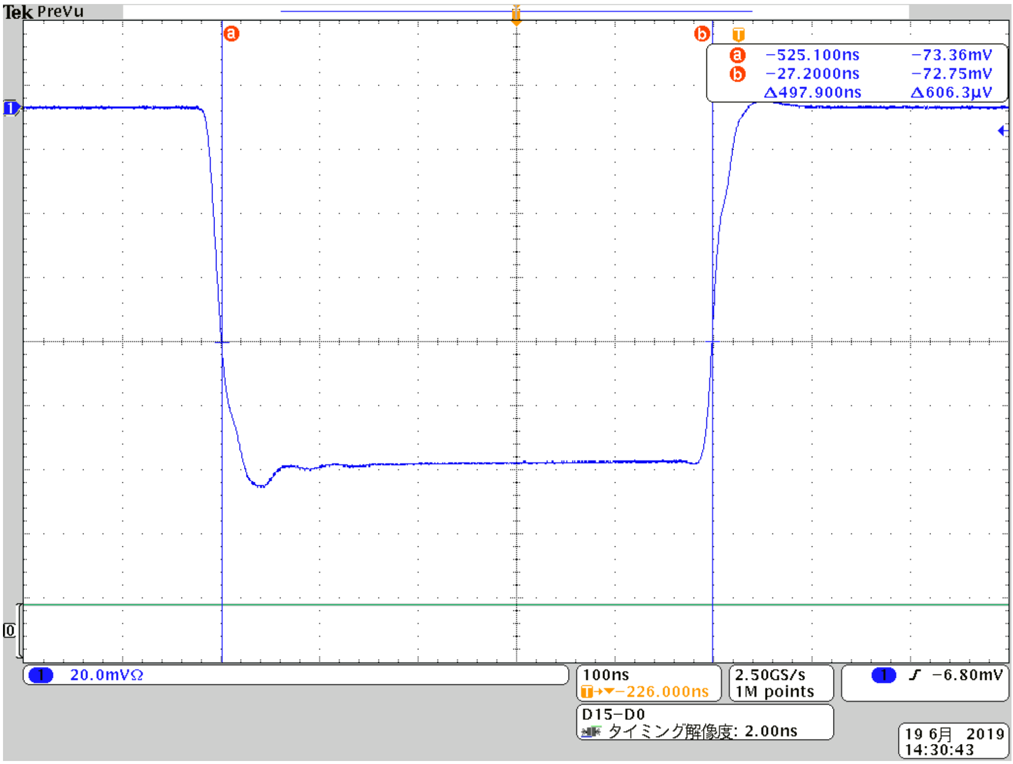


Fig. 6.5 ch1, P0N, M2 pulse envelope

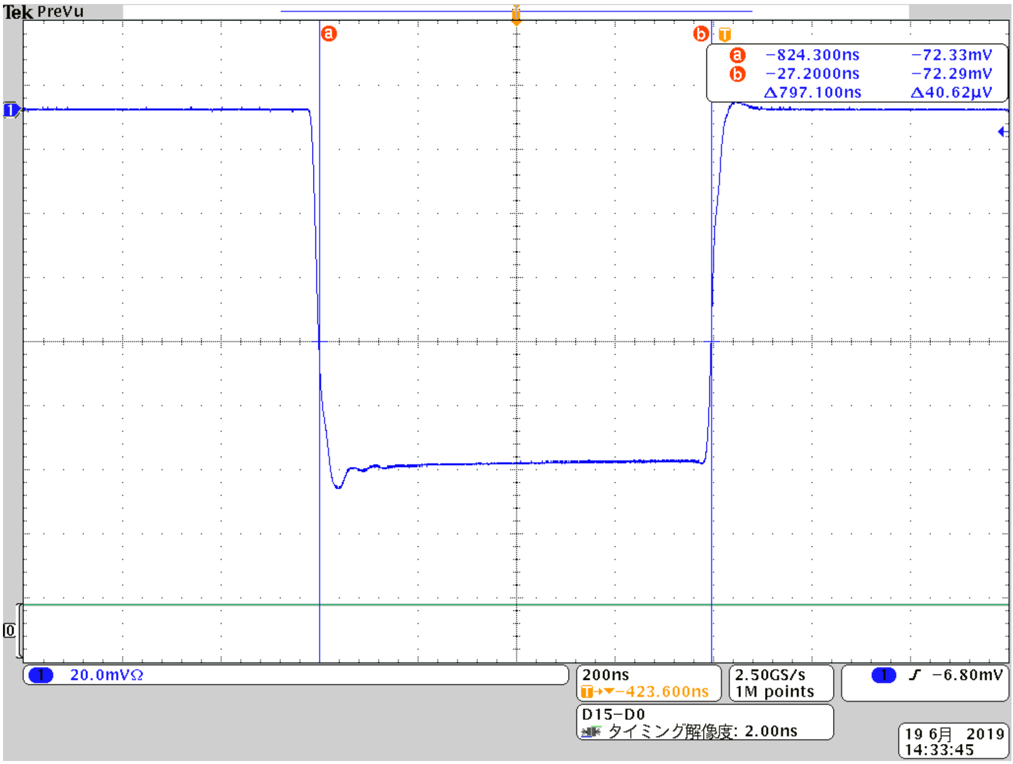


Fig. 6.6 ch1, P0N, M3 pulse envelope

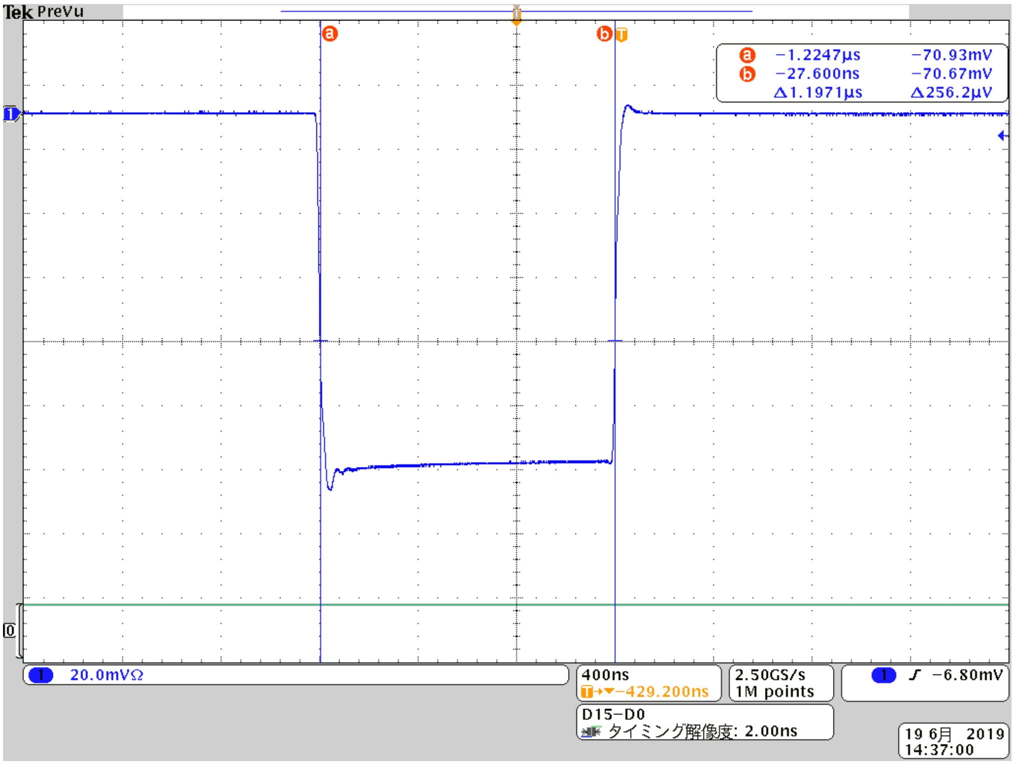


Fig. 6.7 ch1, P0N, L1 pulse envelope

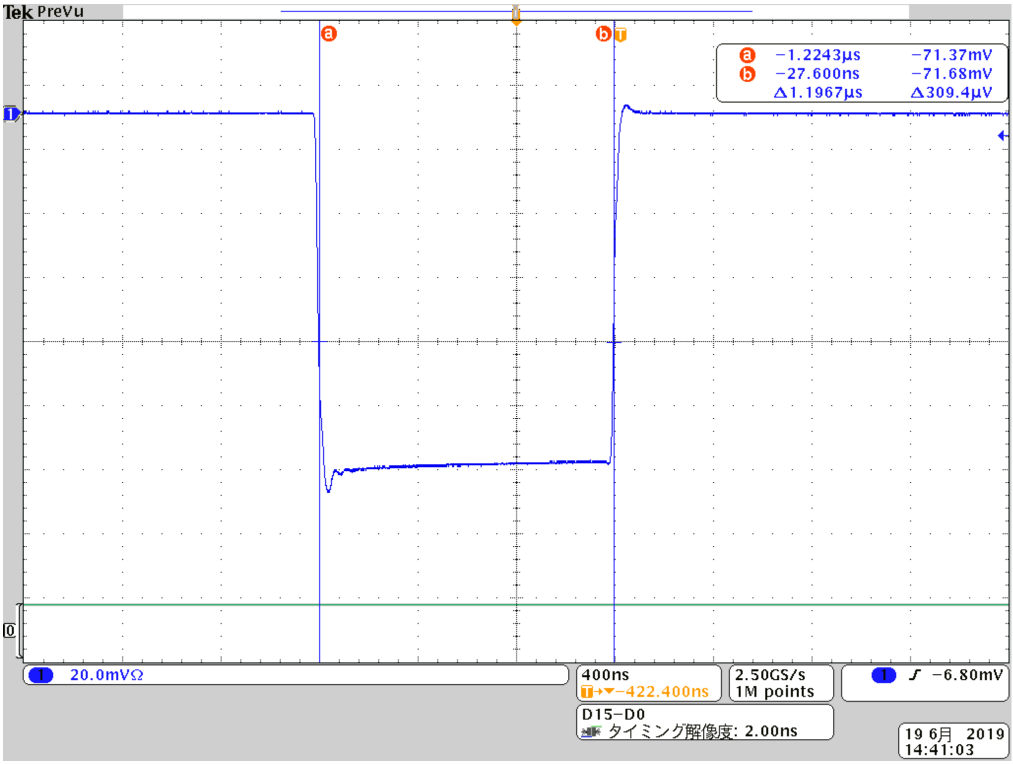


Fig. 6.8 ch1, P0N, L2 pulse envelope

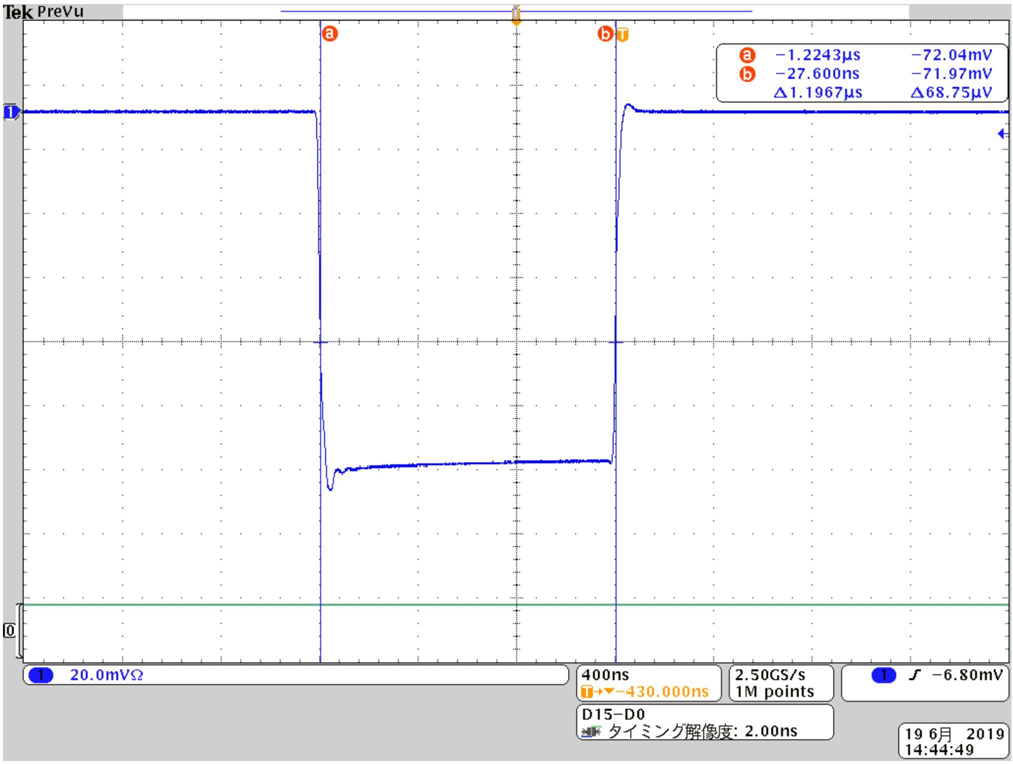


Fig. 6.9 ch1, P0N, L2 pulse envelope

ch1, Q0N

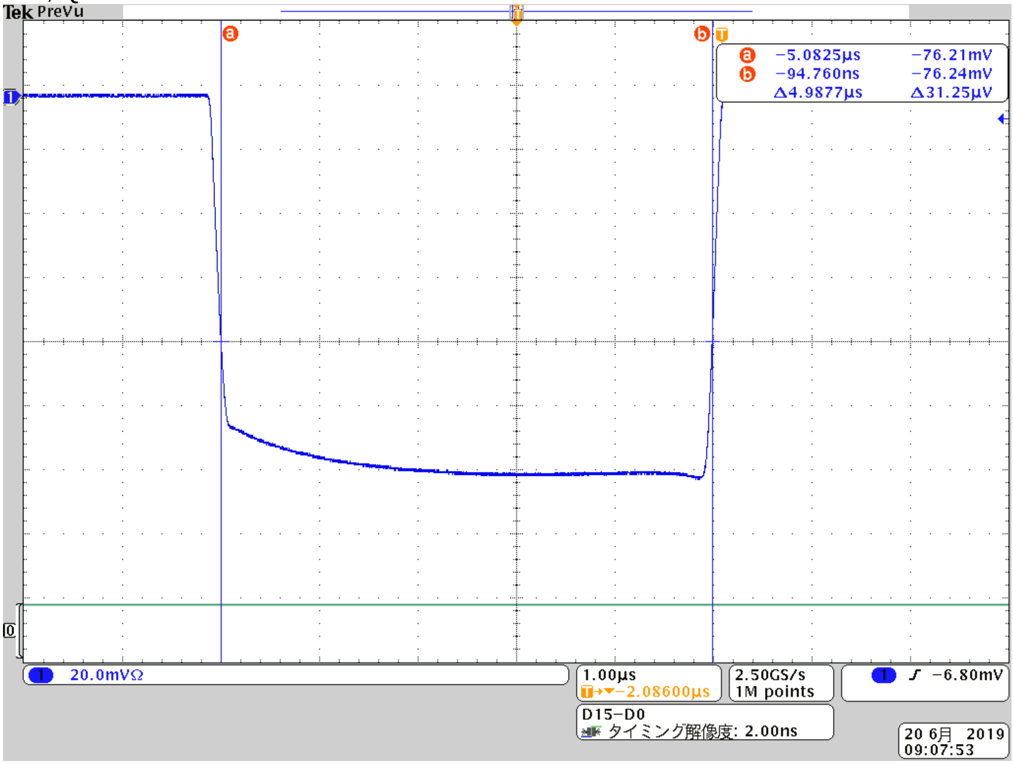


Fig. 6.10 ch1, Q0N, S0 pulse envelope

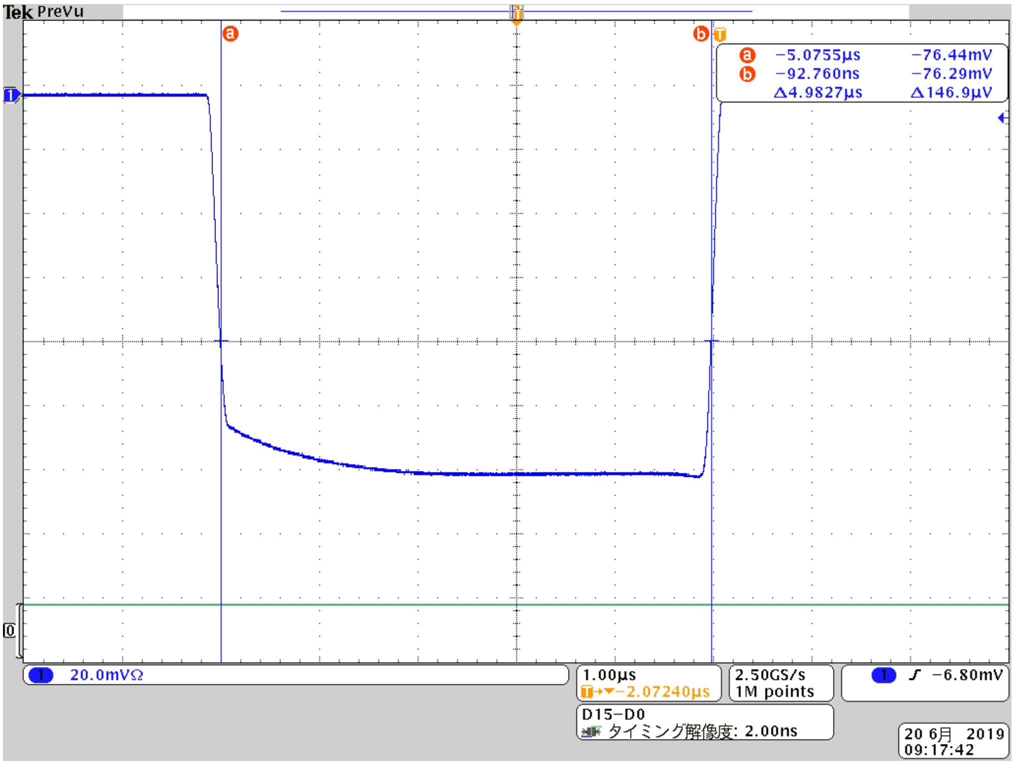


Fig. 6.11 ch1, Q0N, S1 pulse envelope

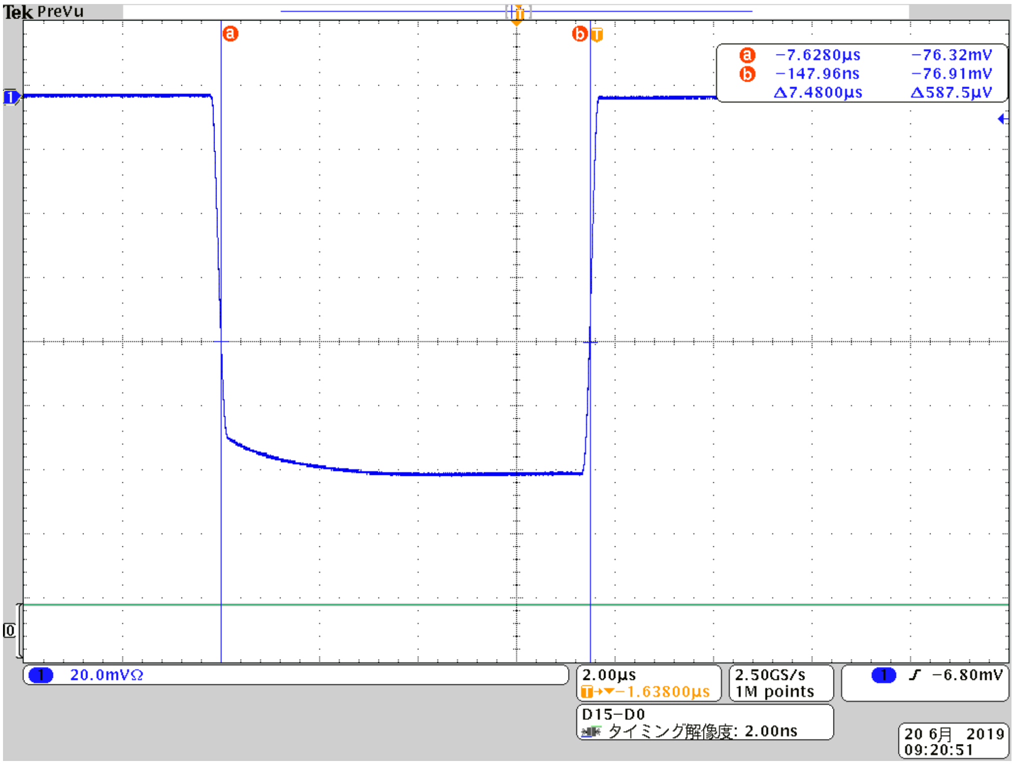


Fig. 6.12 ch1, Q0N, S2 pulse envelope

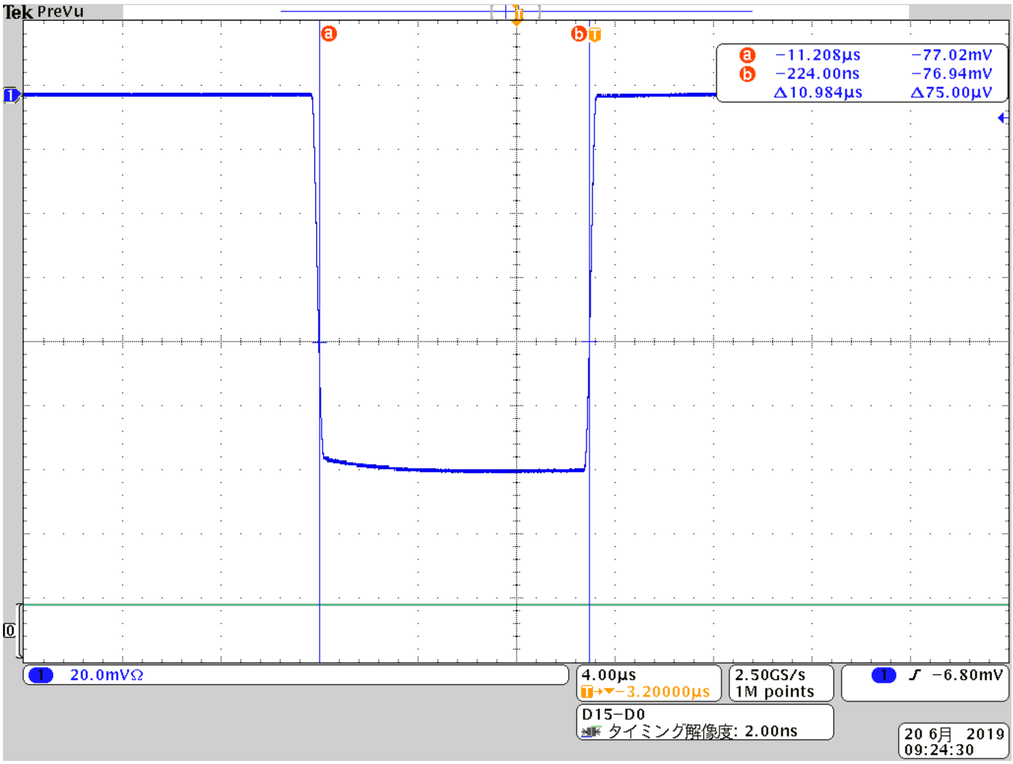


Fig. 6.13 ch1, Q0N, M1 pulse envelope

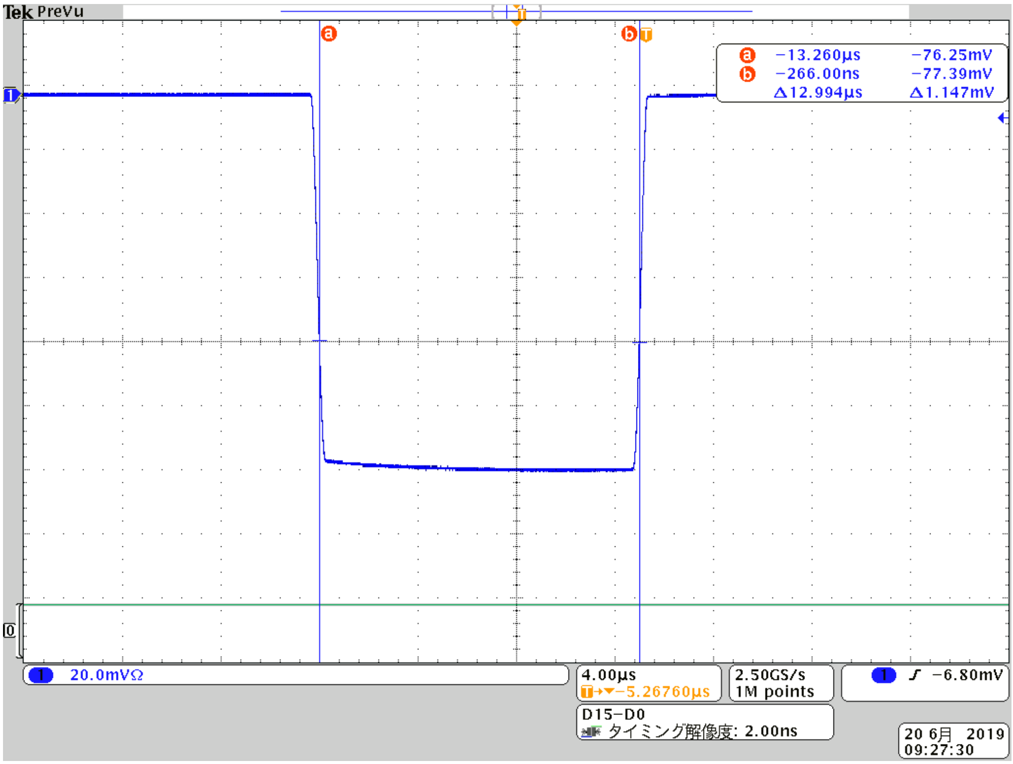


Fig. 6.14 ch1, Q0N, M2 pulse envelope

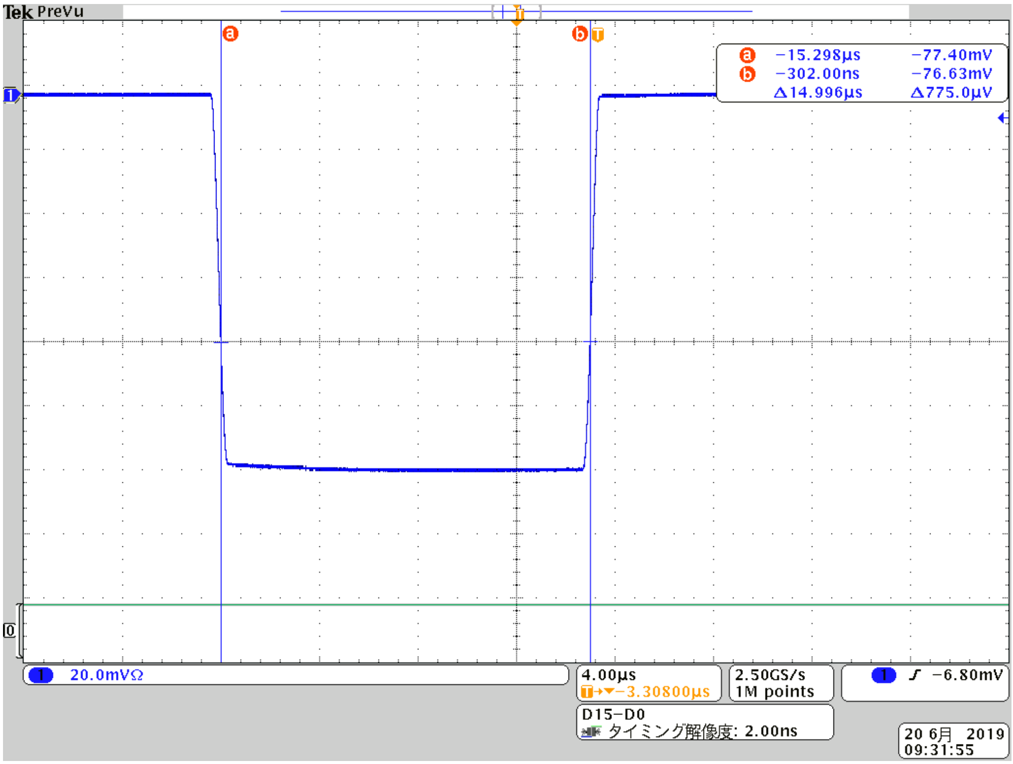


Fig. 6.15 ch1, Q0N, M3 pulse envelope

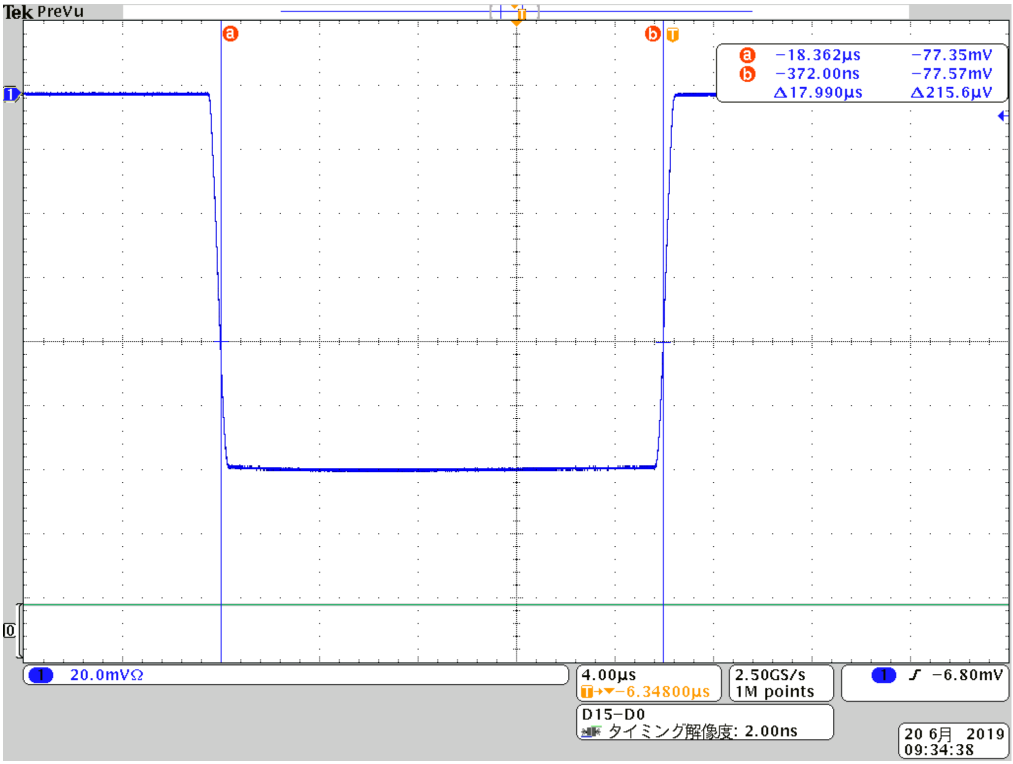


Fig. 6.16 ch1, Q0N, L1 pulse envelope

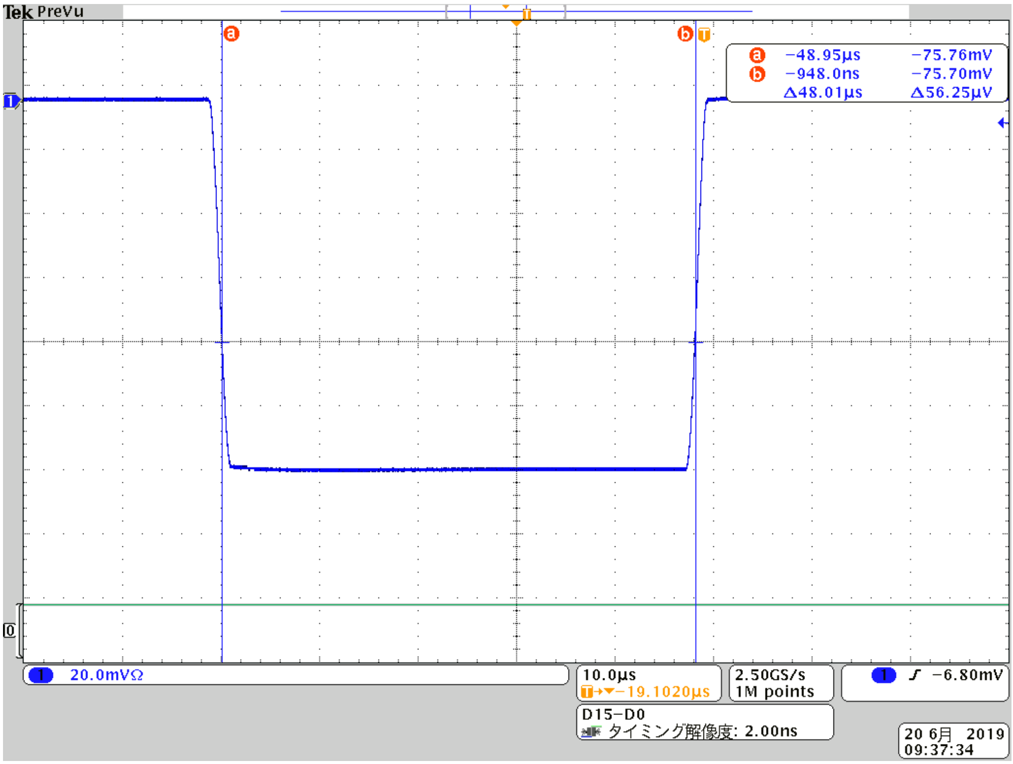


Fig. 6.17 ch1, Q0N, L2 pulse envelope

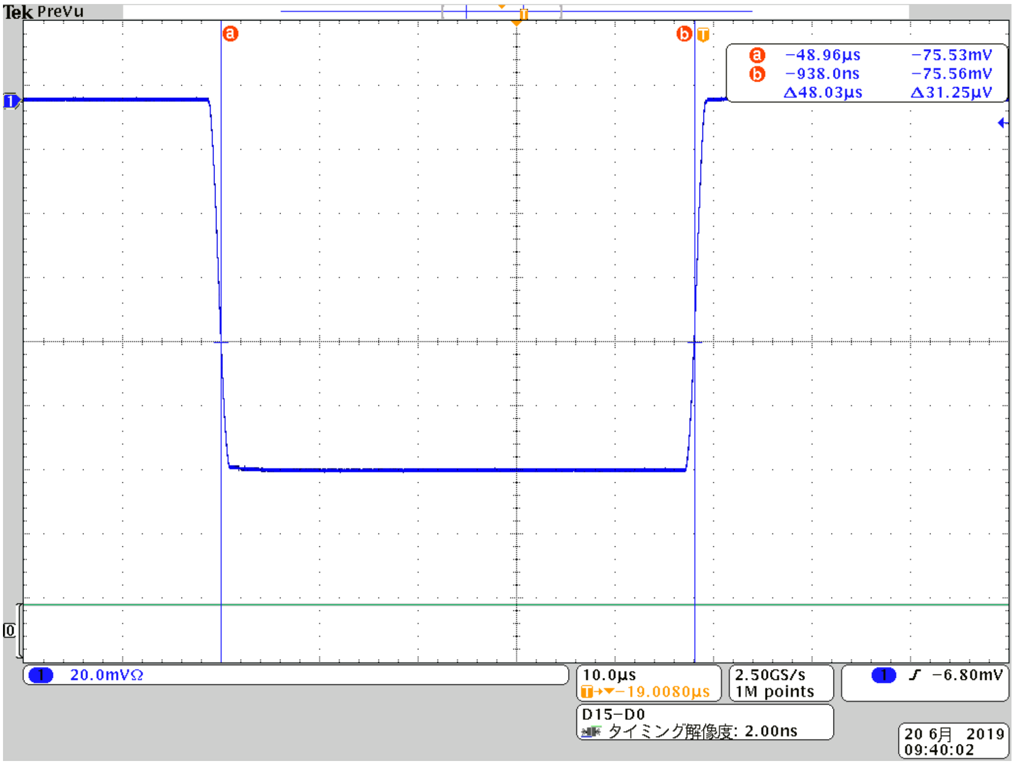


Fig. 6.18 ch1, Q0N, L2 pulse envelope

ch2, P0N

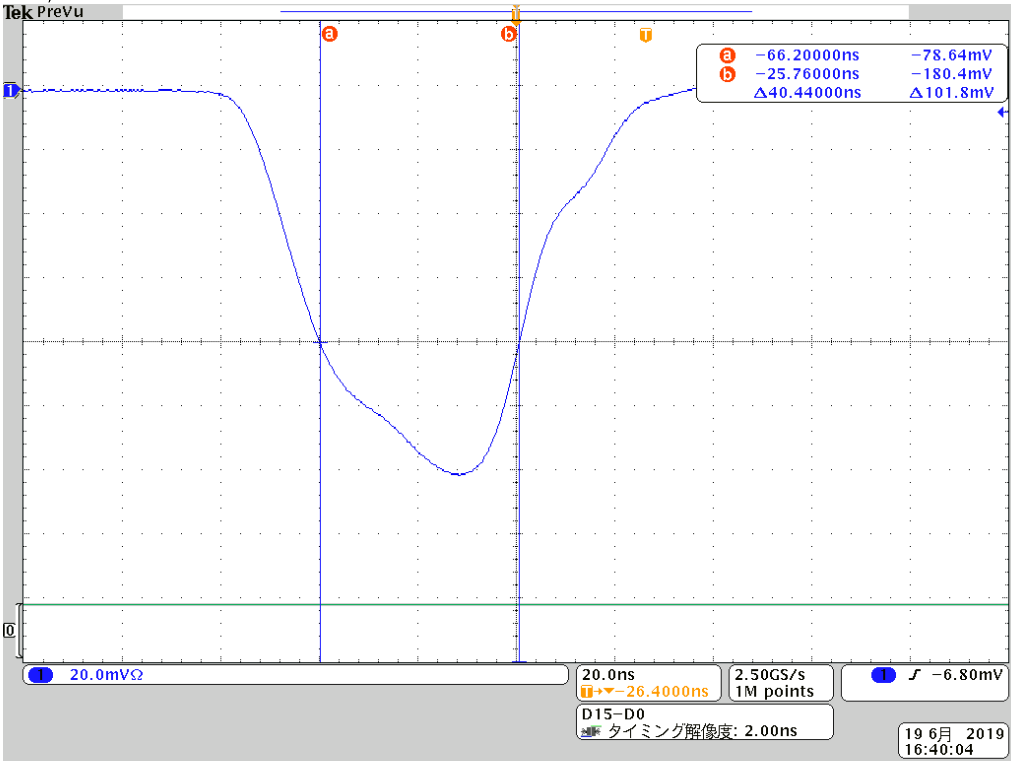


Fig. 6.19 ch2, P0N, S0 pulse envelope

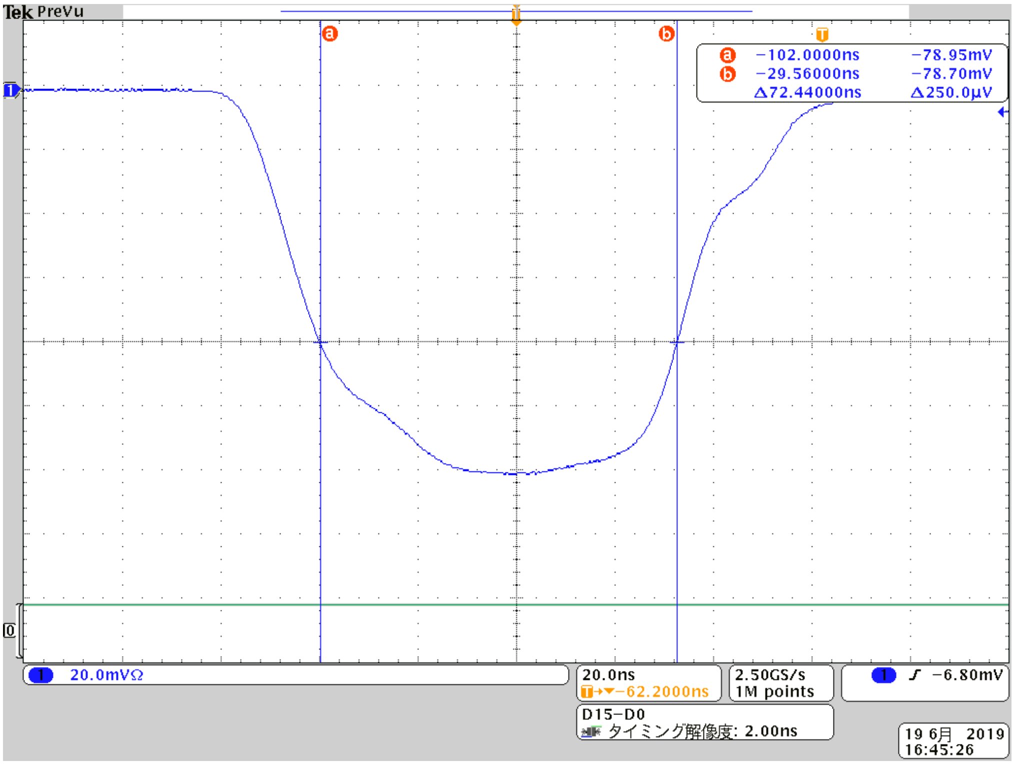


Fig. 6.20 ch2, P0N, S1 pulse envelope

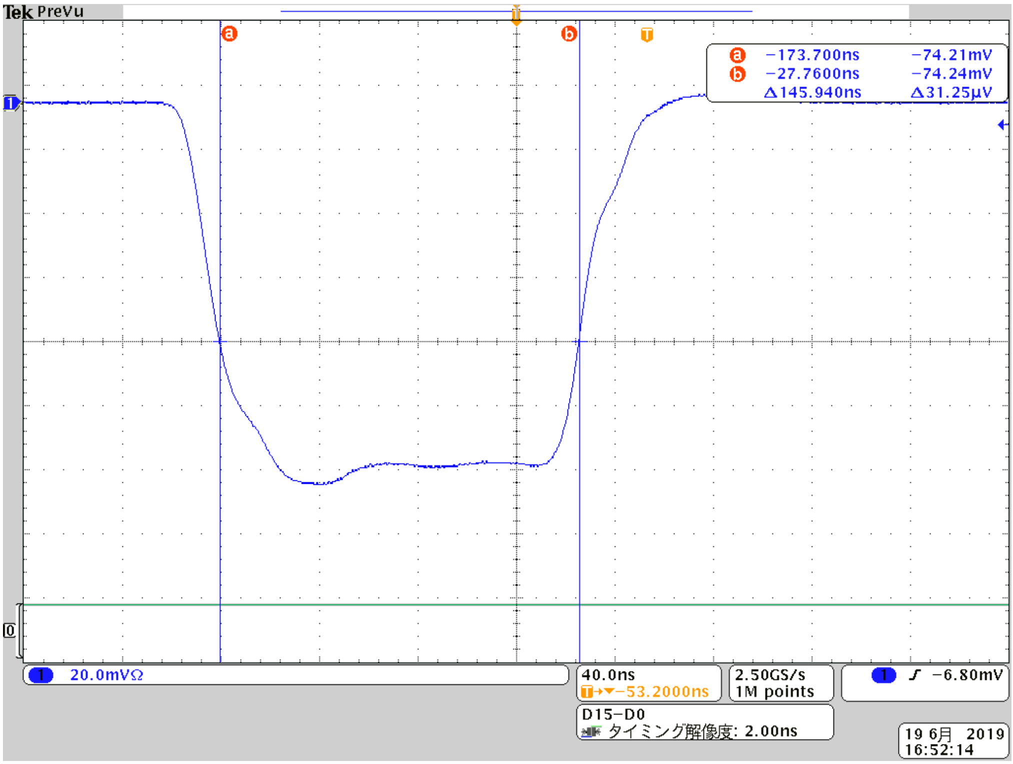


Fig. 6.21 ch2, P0N, S2 pulse envelope

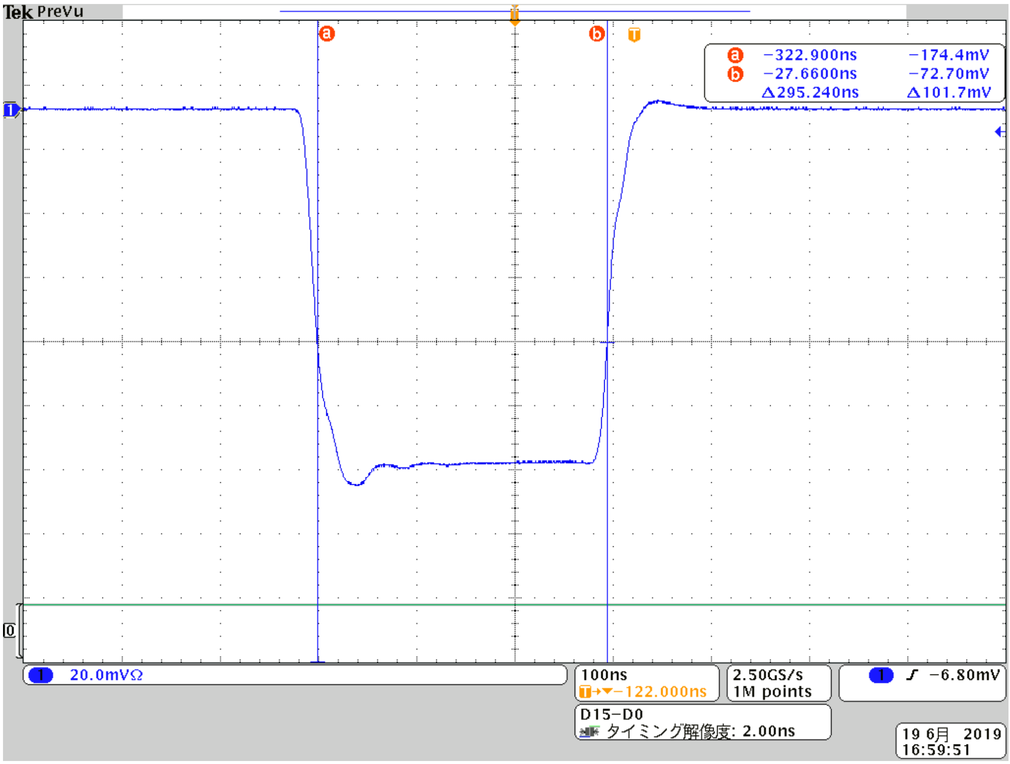


Fig. 6.22 ch2, P0N, M1 pulse envelope

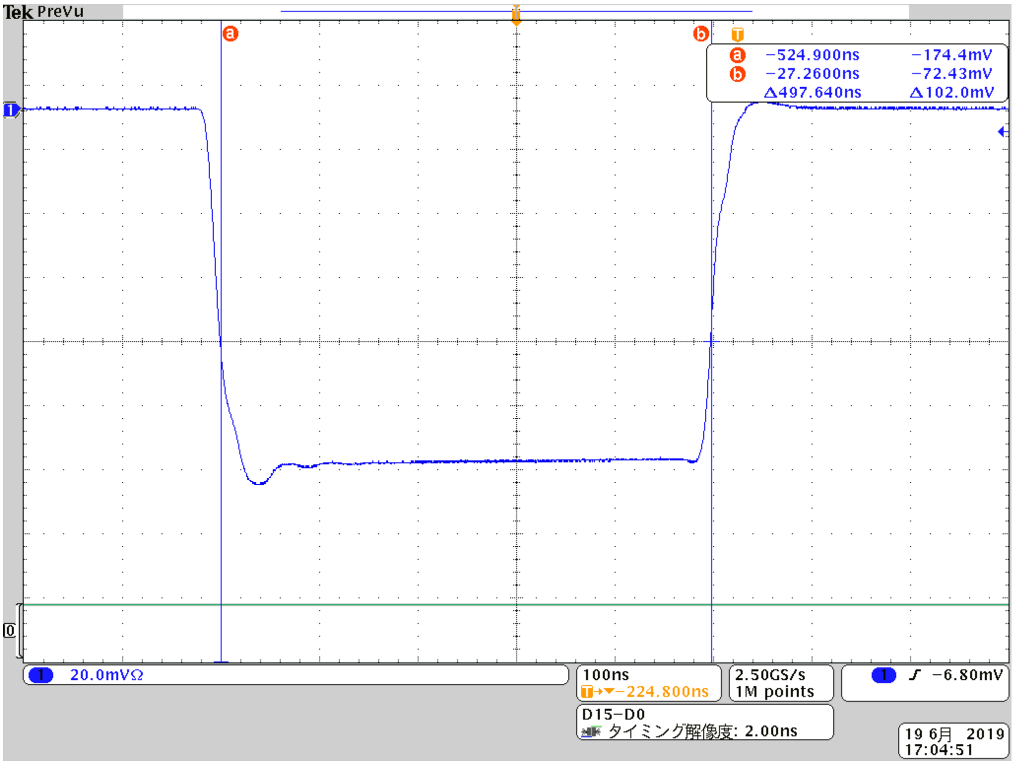


Fig. 6.23 ch2, P0N, M2 pulse envelope

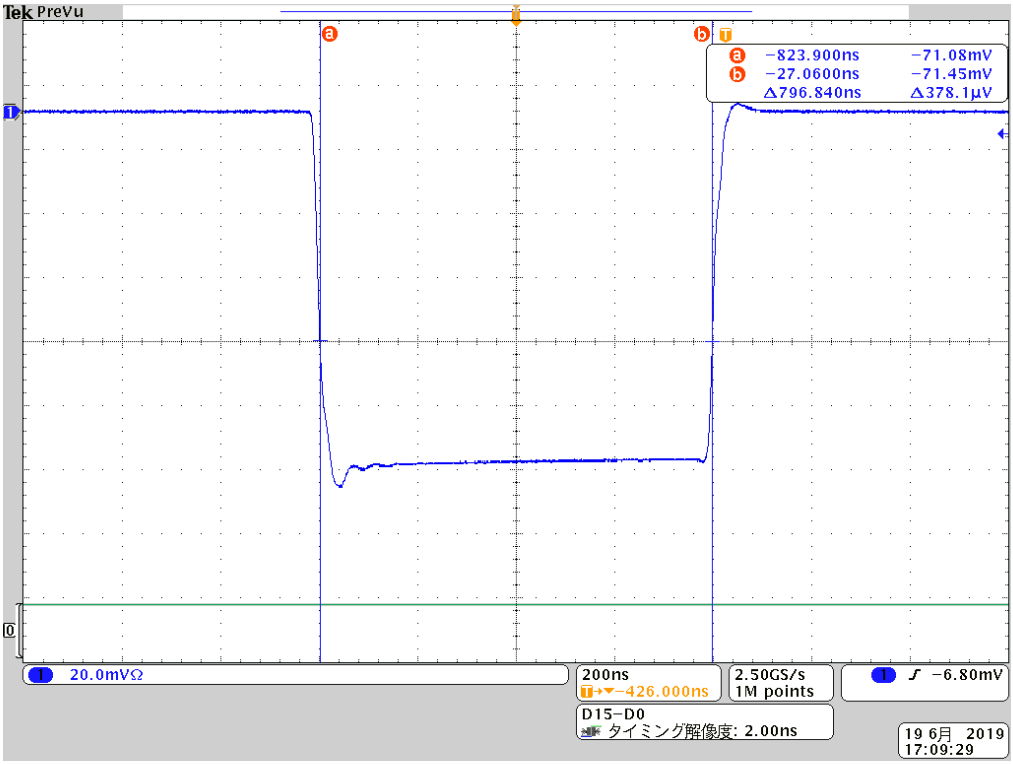


Fig. 6.24 ch2, P0N, M3 pulse envelope

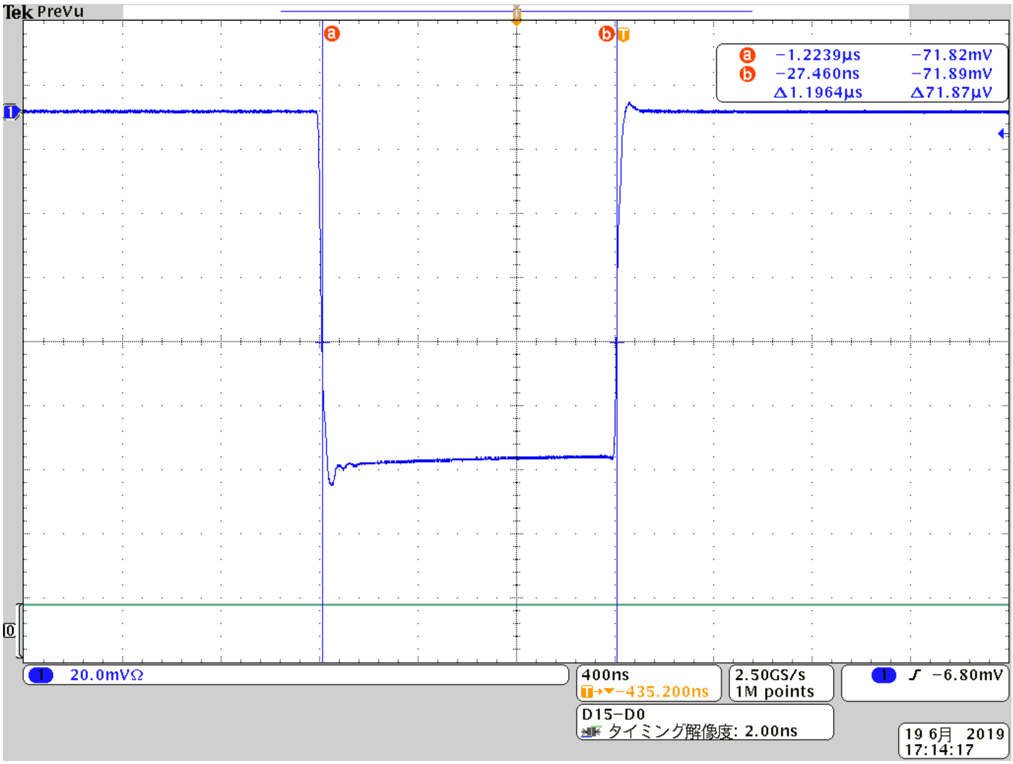


Fig. 6.25 ch2, P0N, L1 pulse envelope

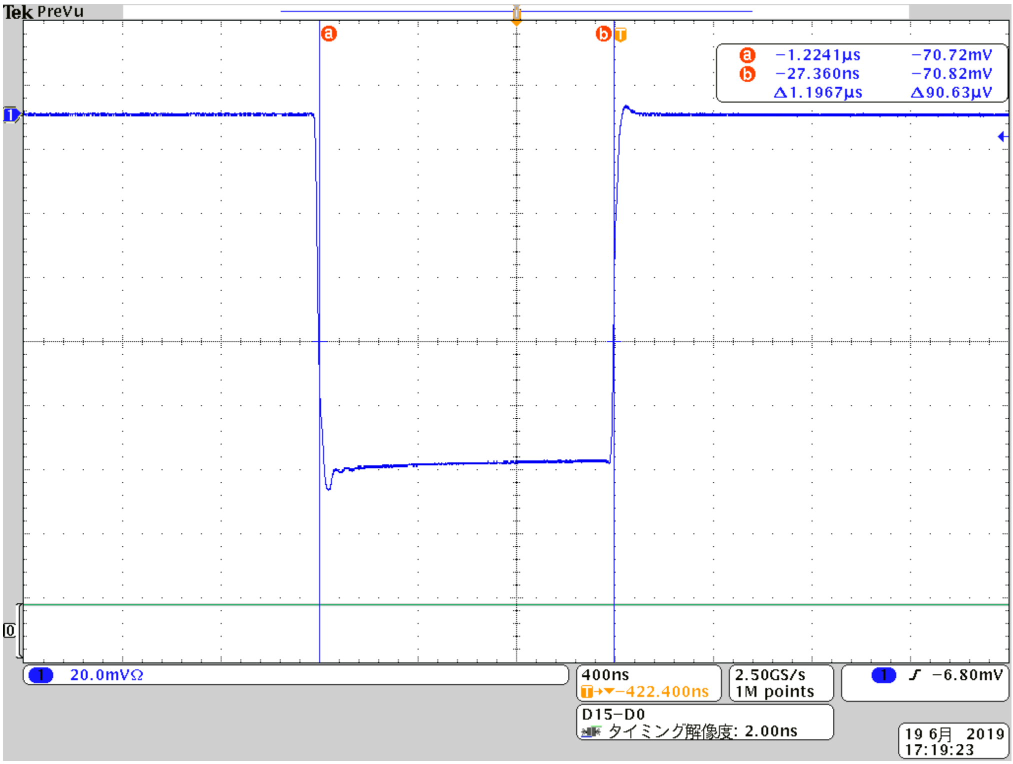


Fig. 6.26 ch2, P0N, L2 pulse envelope

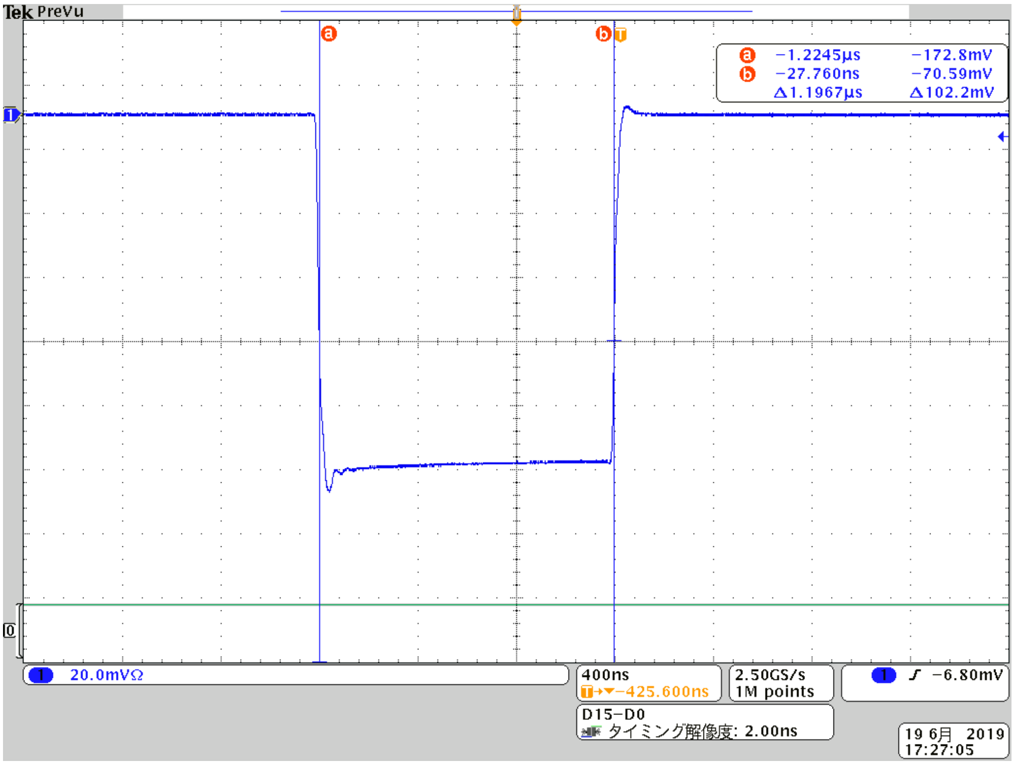


Fig. 6.27 ch2, P0N, L2 pulse envelope

ch2, Q0N

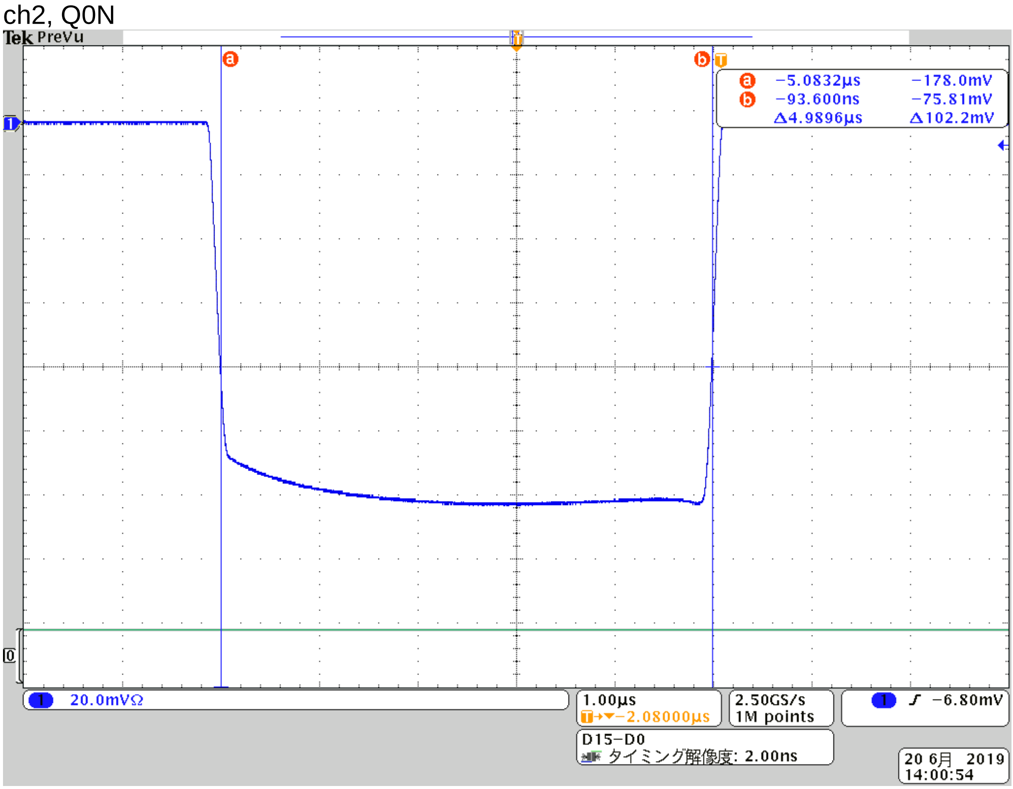


Fig. 6.28 ch2, Q0N, S0 pulse envelope

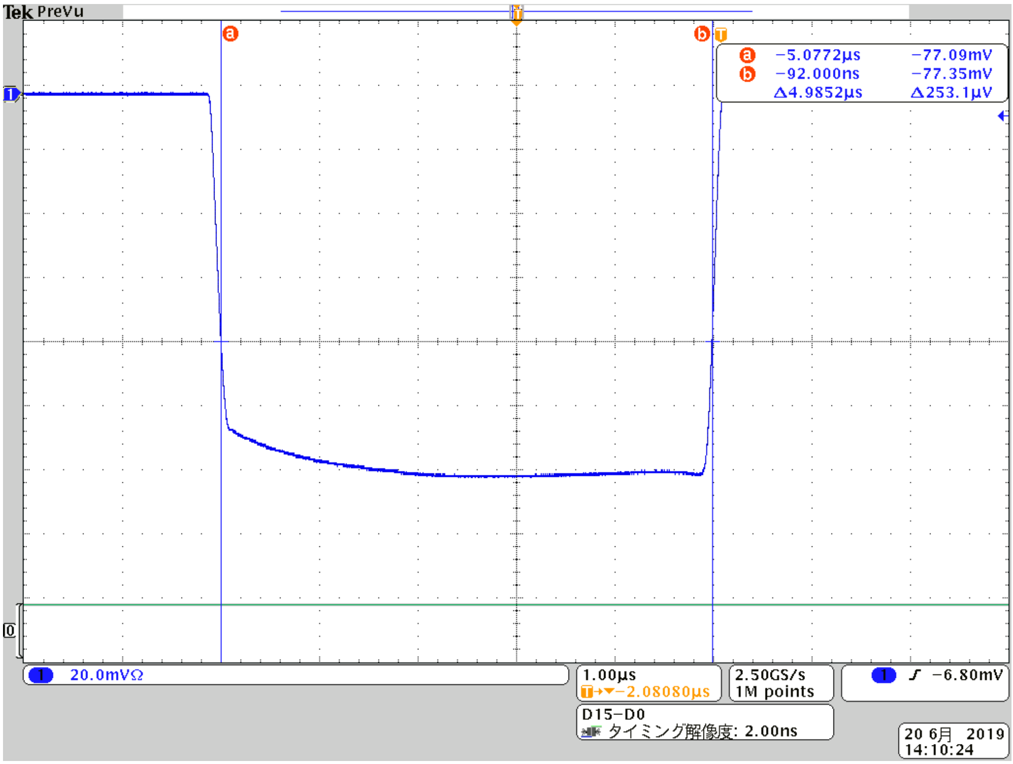


Fig. 6.29 ch2, Q0N, S1 pulse envelope

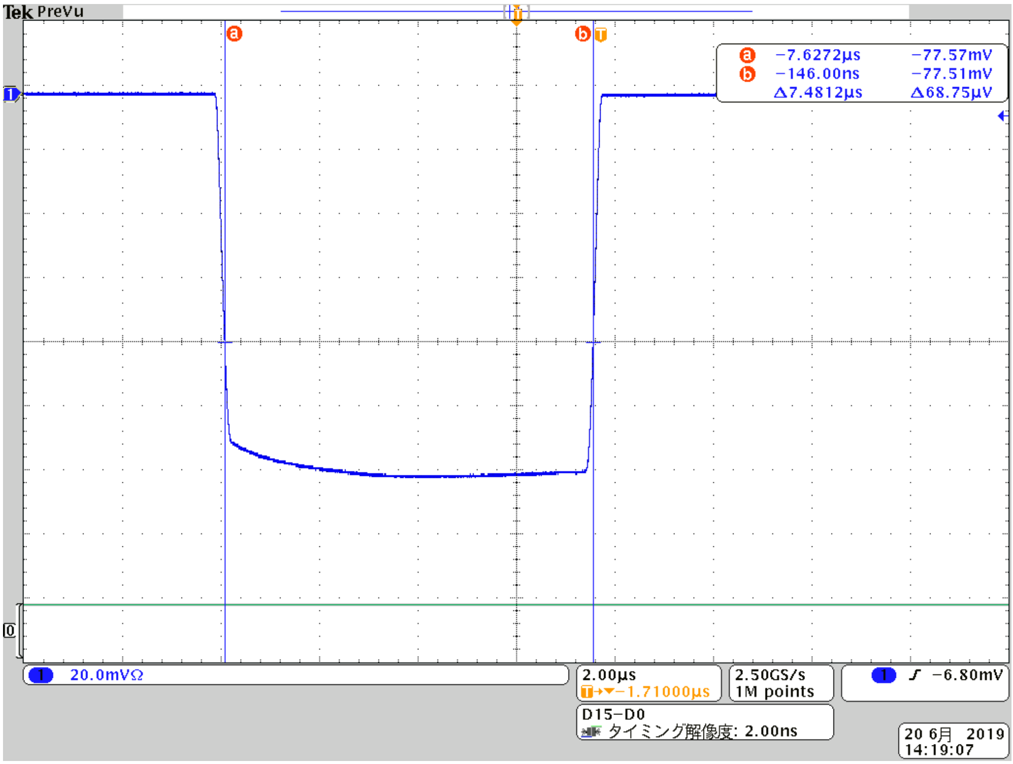


Fig. 6.30 ch2, Q0N, S2 pulse envelope

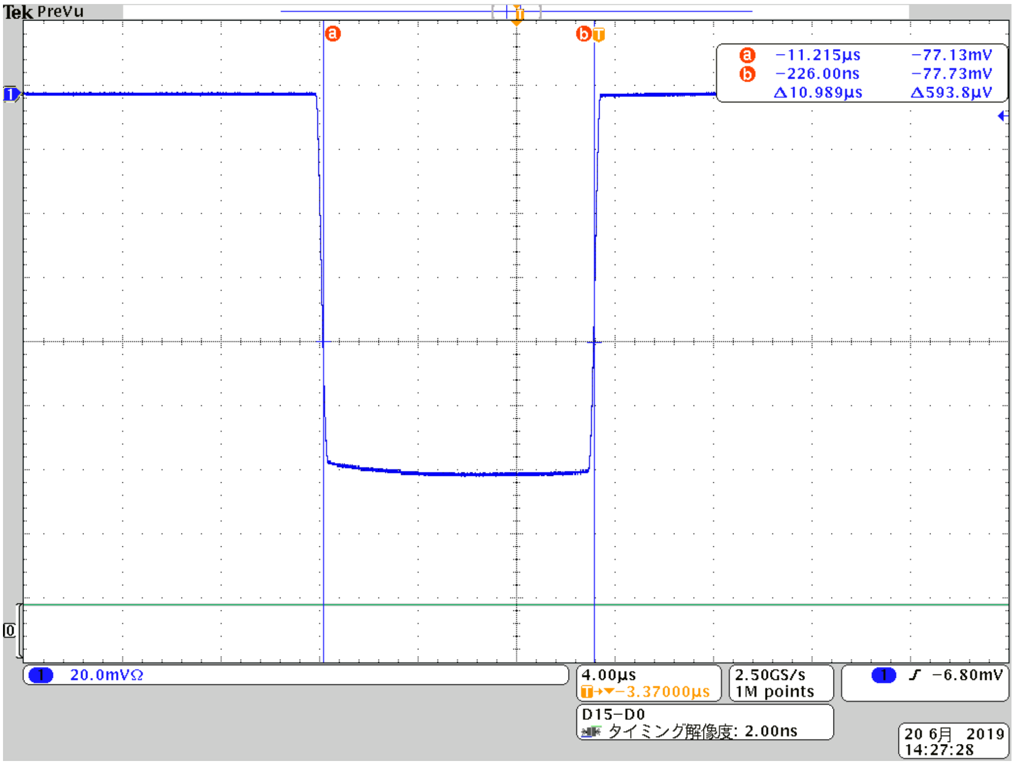


Fig. 6.31 ch2, Q0N, M1 pulse envelope

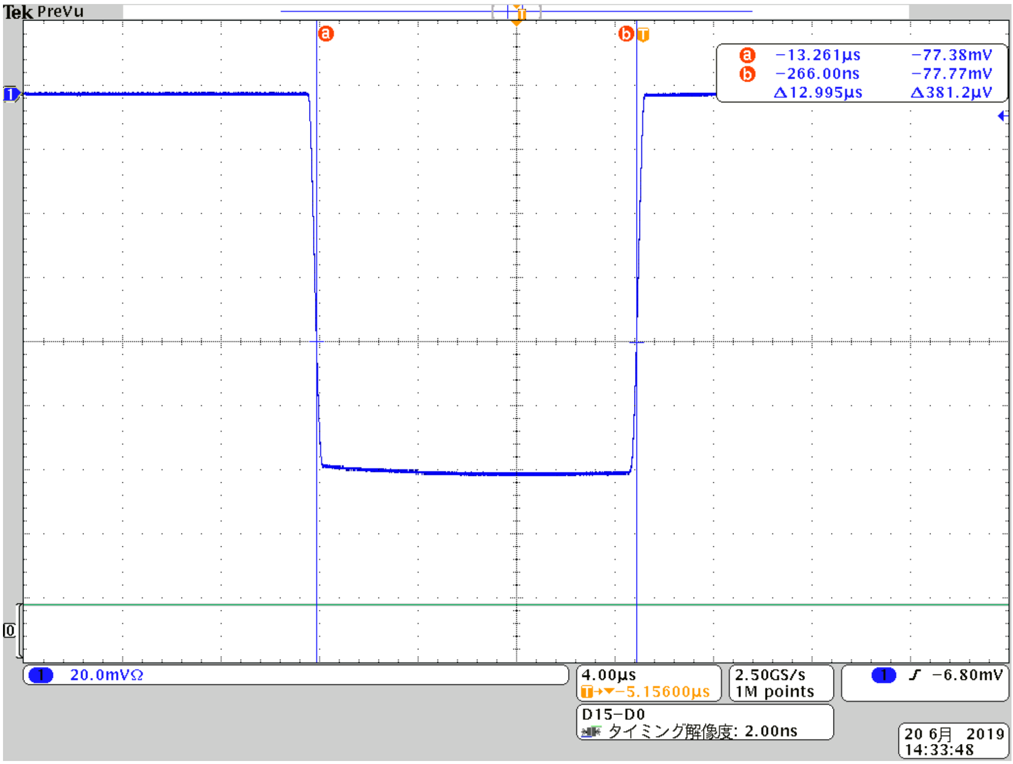


Fig. 6.32 ch2, Q0N, M2 pulse envelope

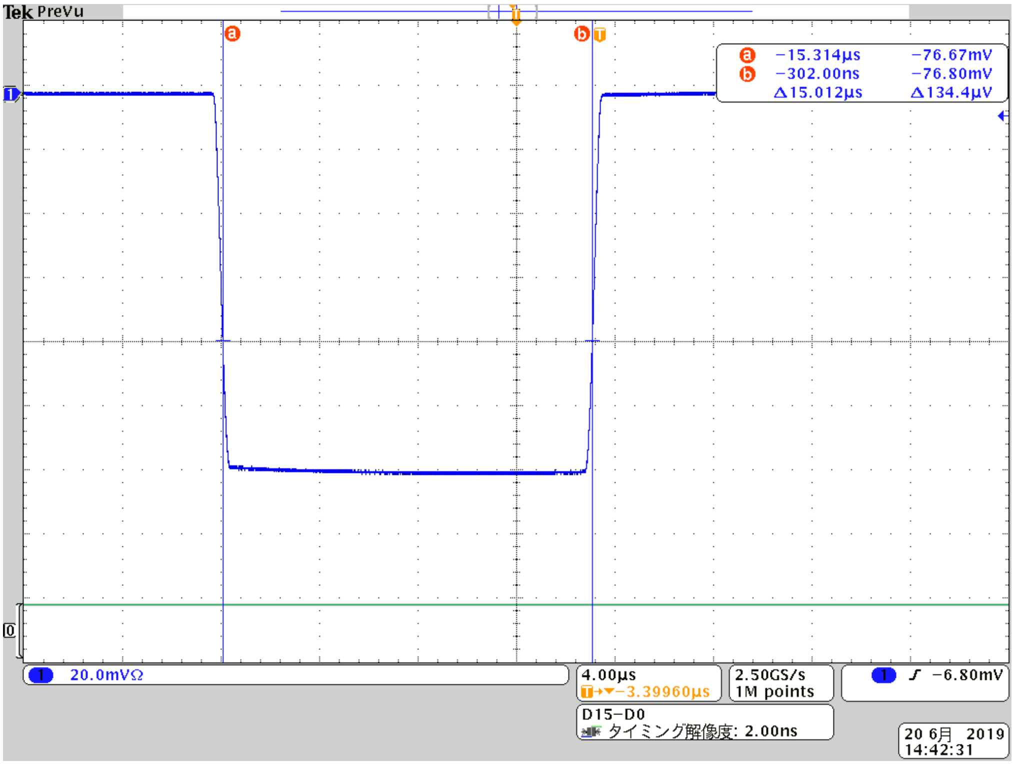


Fig. 6.33 ch2, Q0N, M3 pulse envelope

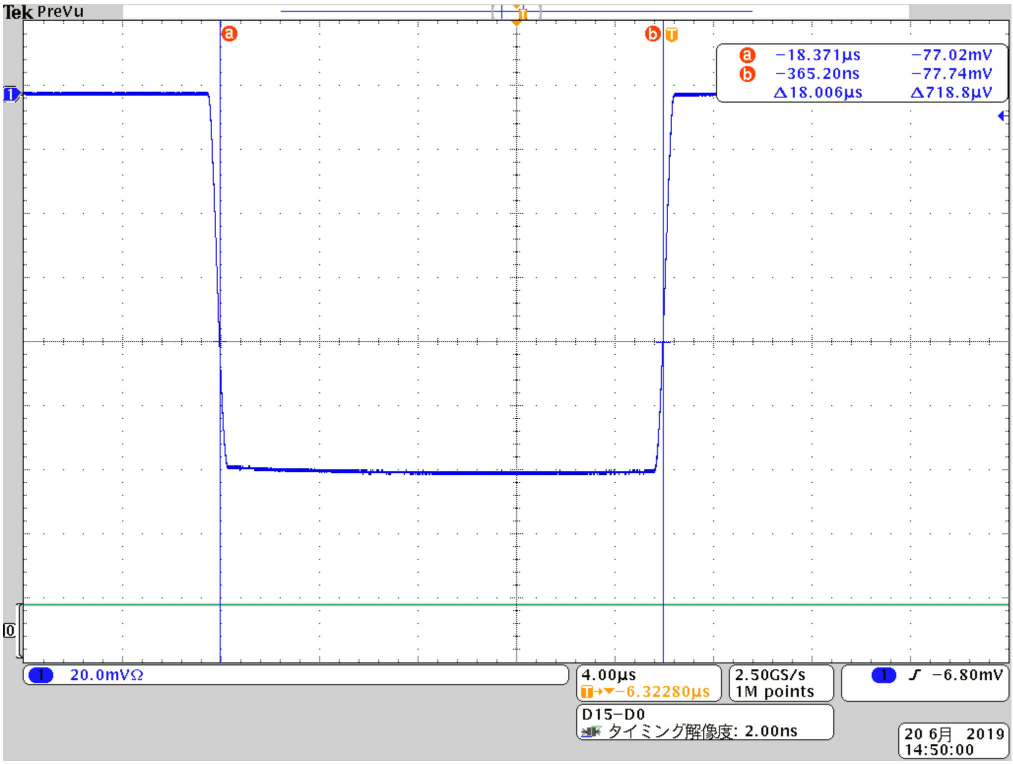


Fig. 6.34 ch2, Q0N, L1 pulse envelope

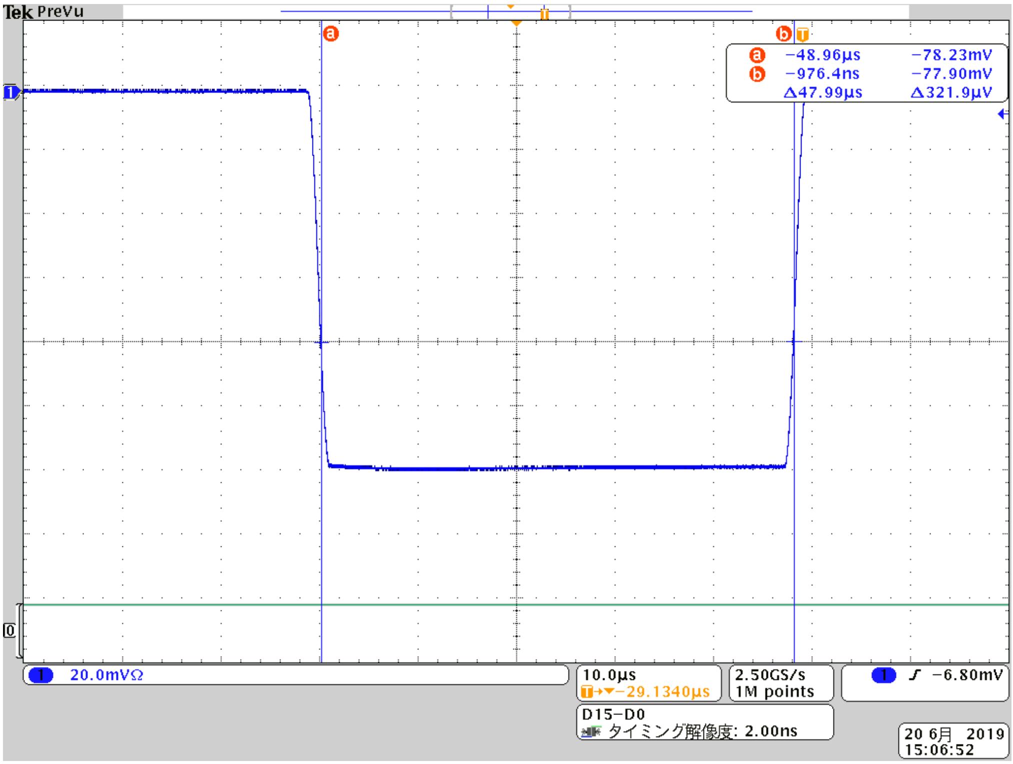


Fig. 6.35 ch2, Q0N, L2 pulse envelope

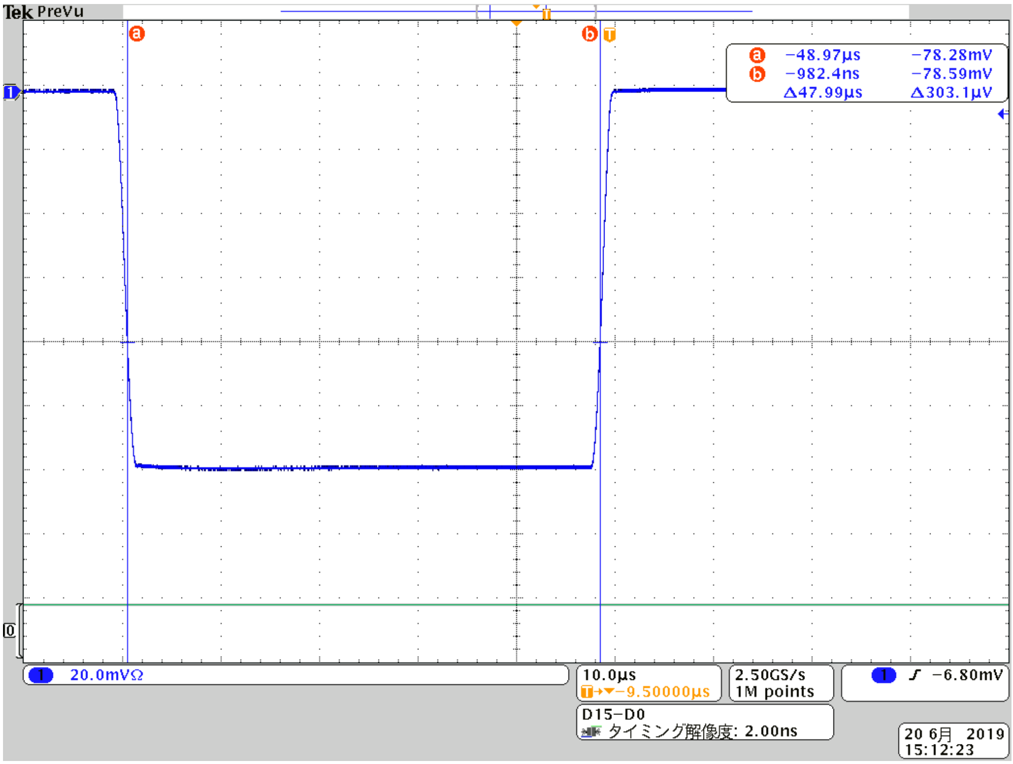


Fig. 6.36 ch2, Q0N, L2 pulse envelope

ch3, P0N

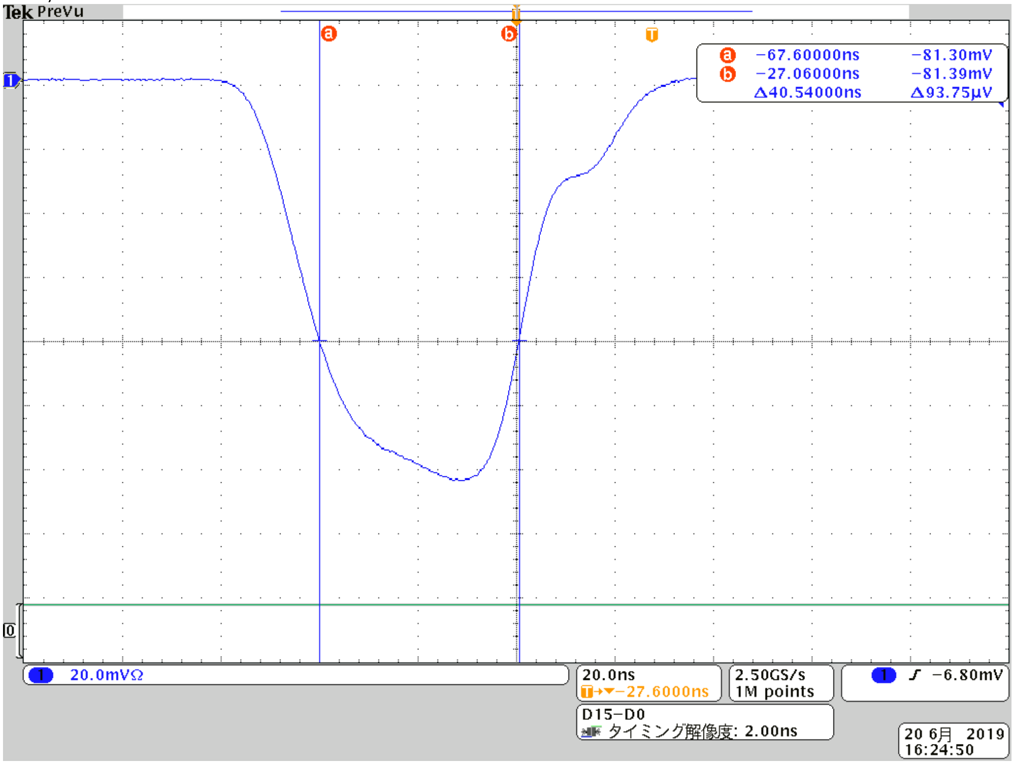


Fig. 6.37 ch3, P0N, S0 pulse envelope

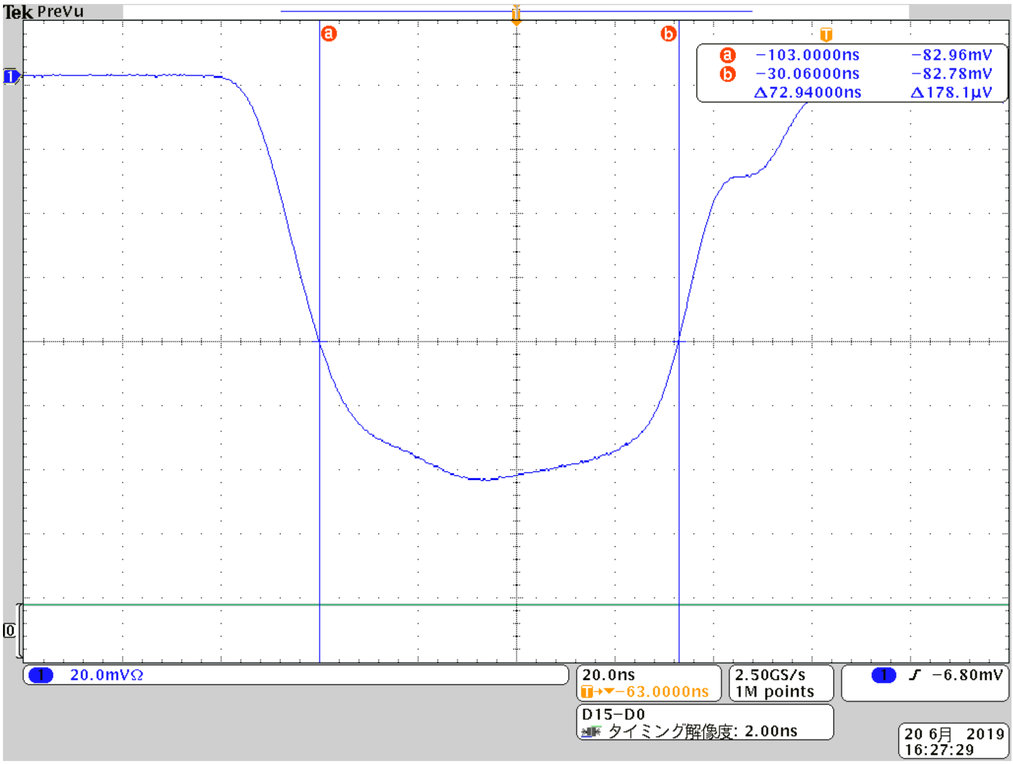


Fig. 6.38 ch3, P0N, S1 pulse envelope

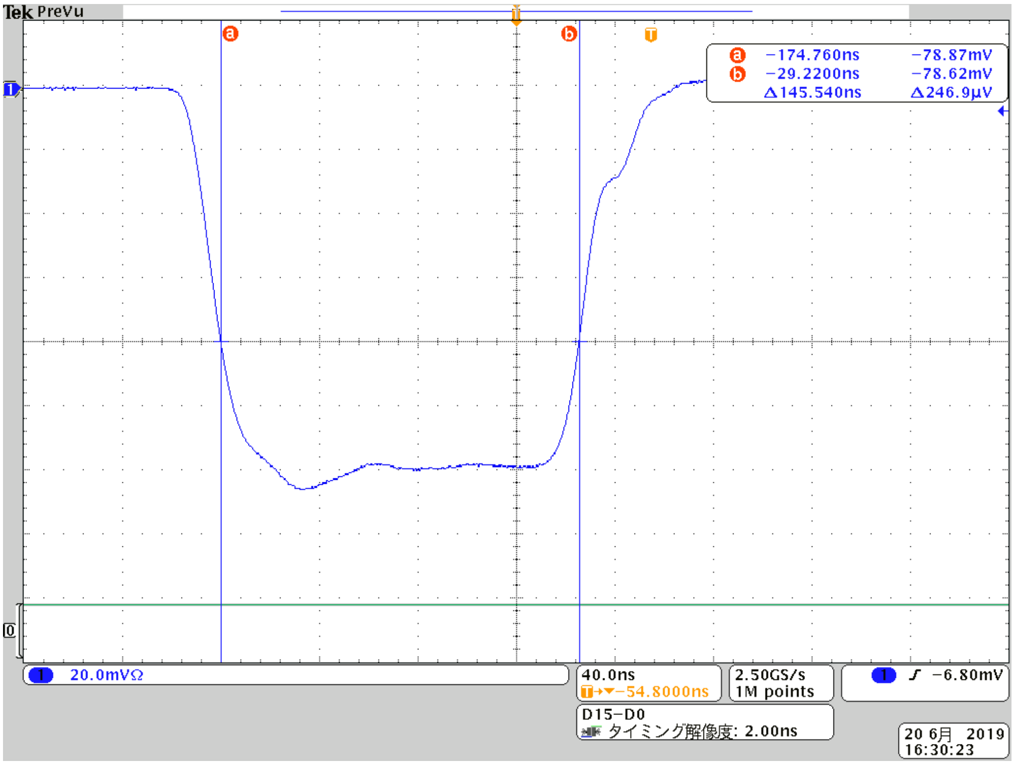


Fig. 6.39 ch3, P0N, S2 pulse envelope

Fig. 6.40 ch3, P0N, M1 pulse envelope

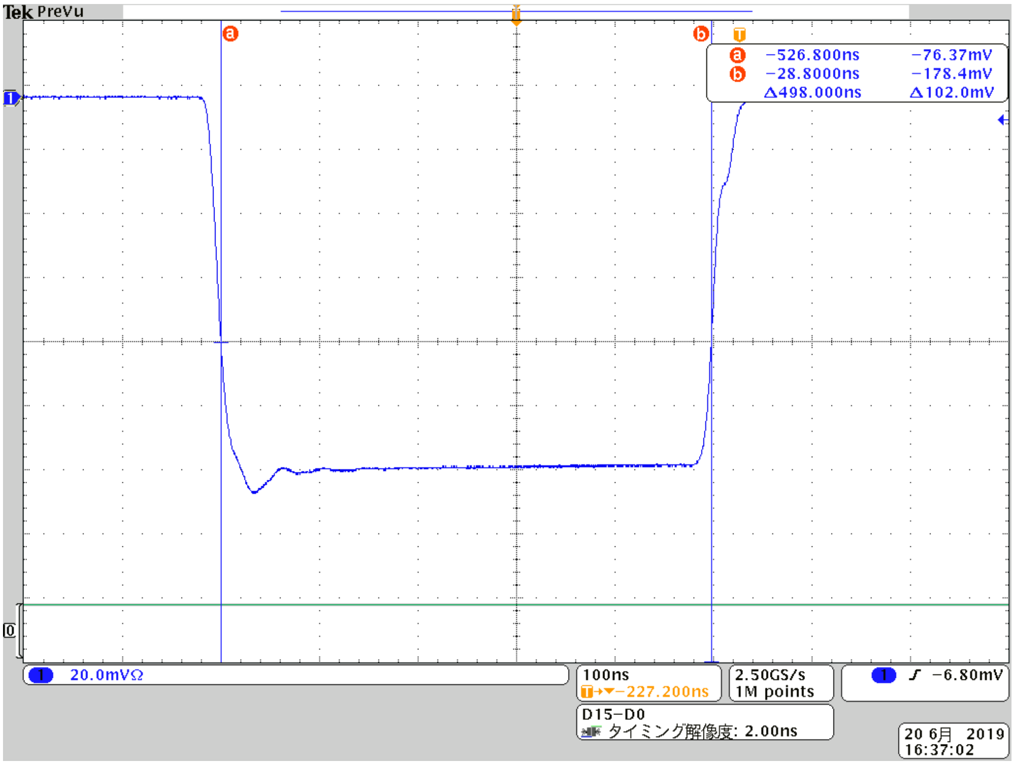


Fig. 6.41 ch3, P0N, M2 pulse envelope

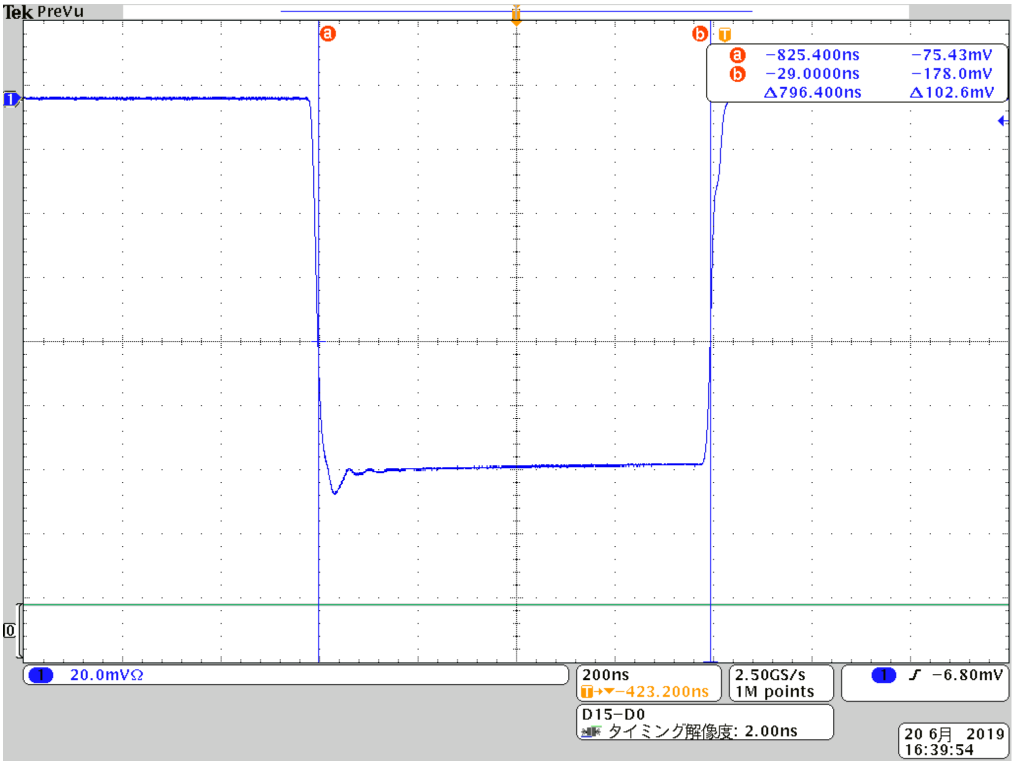


Fig. 6.42 ch3, P0N, M3 pulse envelope

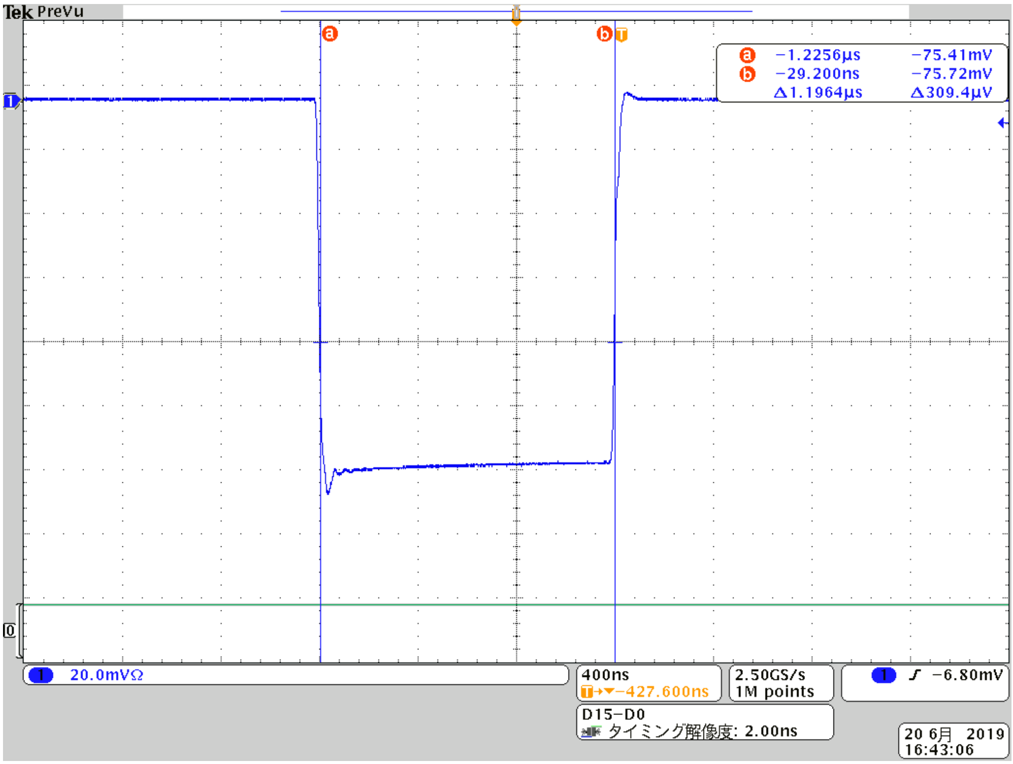


Fig. 6.43 ch3, P0N, L1 pulse envelope

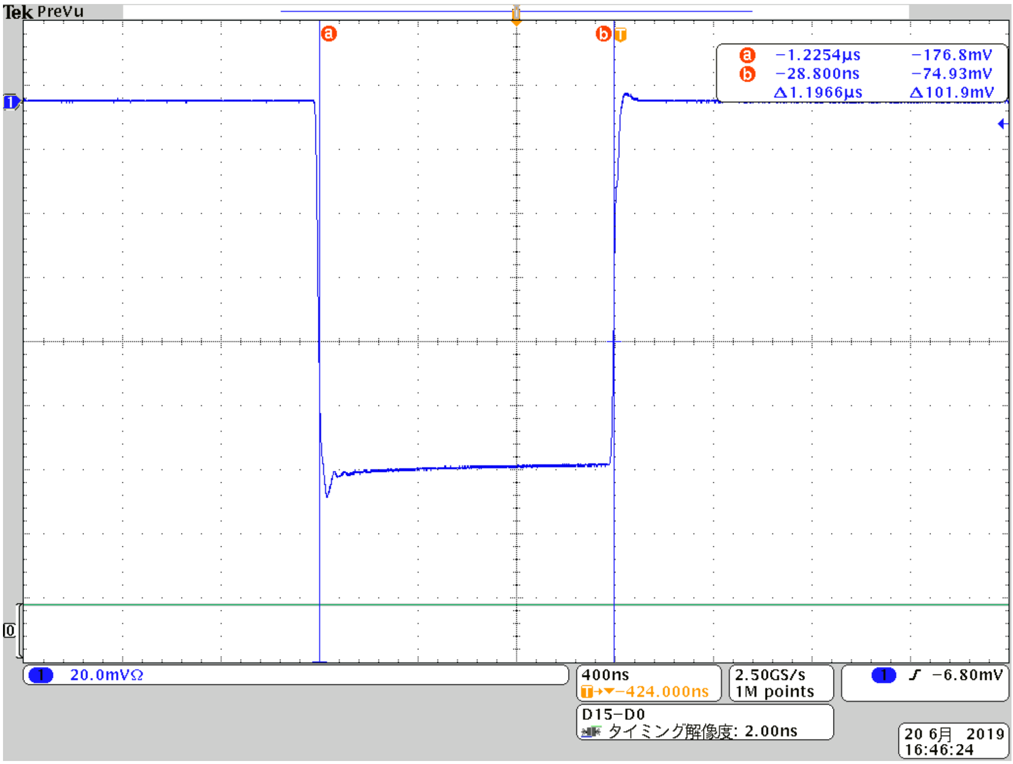


Fig. 6.44 ch3, P0N, L2 pulse envelope

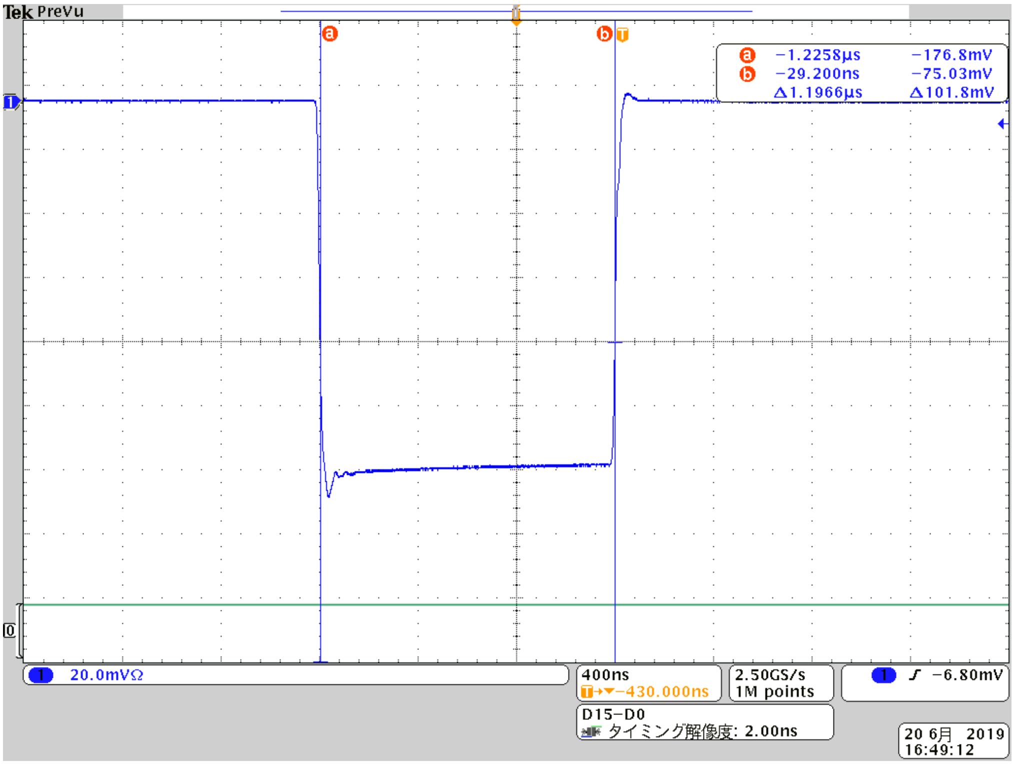


Fig. 6.45 ch3, P0N, L2 pulse envelope

ch3, Q0N

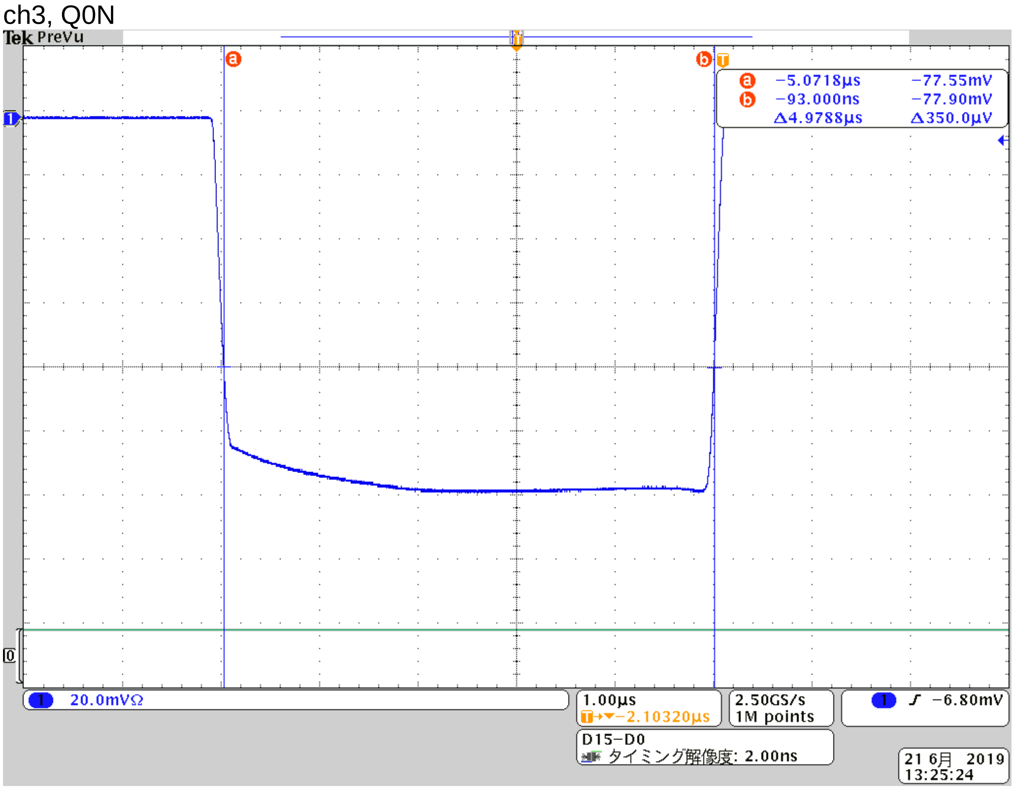


Fig. 6.46 ch3, Q0N, S0 pulse envelope

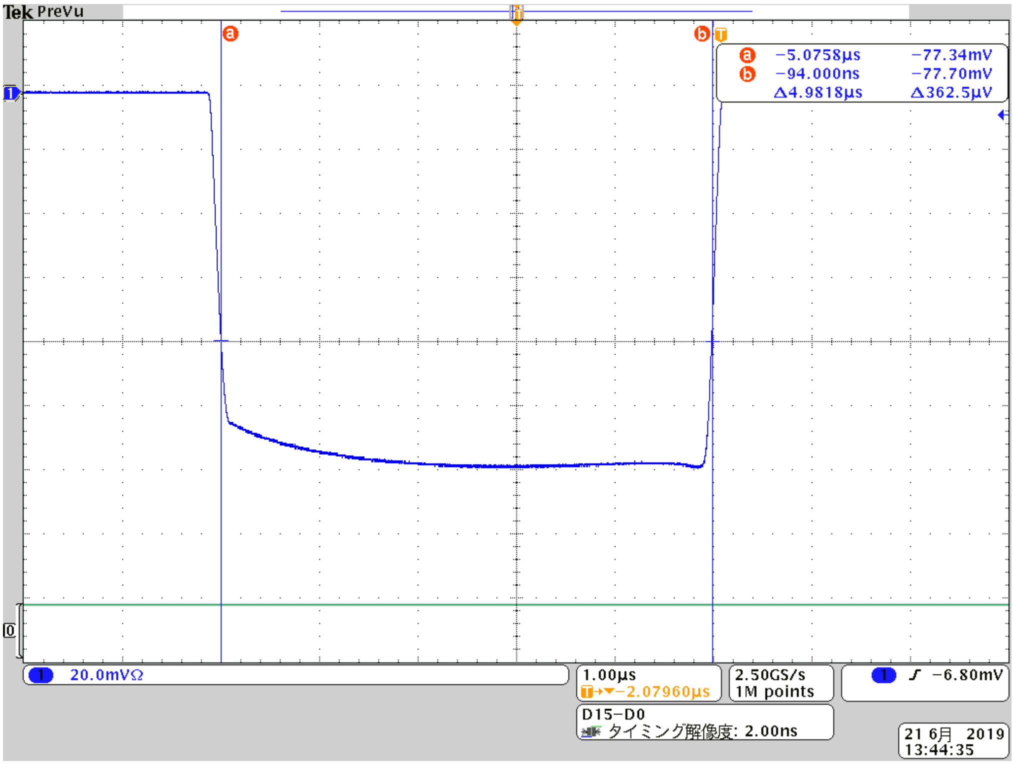


Fig. 6.47 ch3, Q0N, S1 pulse envelope

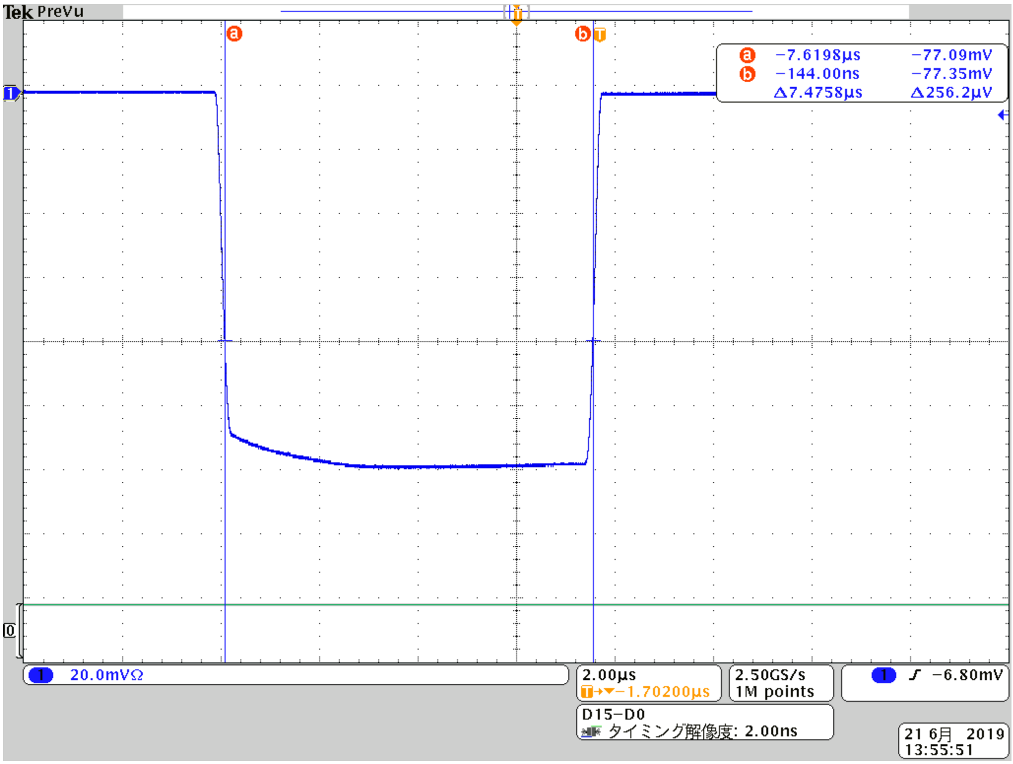


Fig. 6.48 ch3, Q0N, S2 pulse envelope

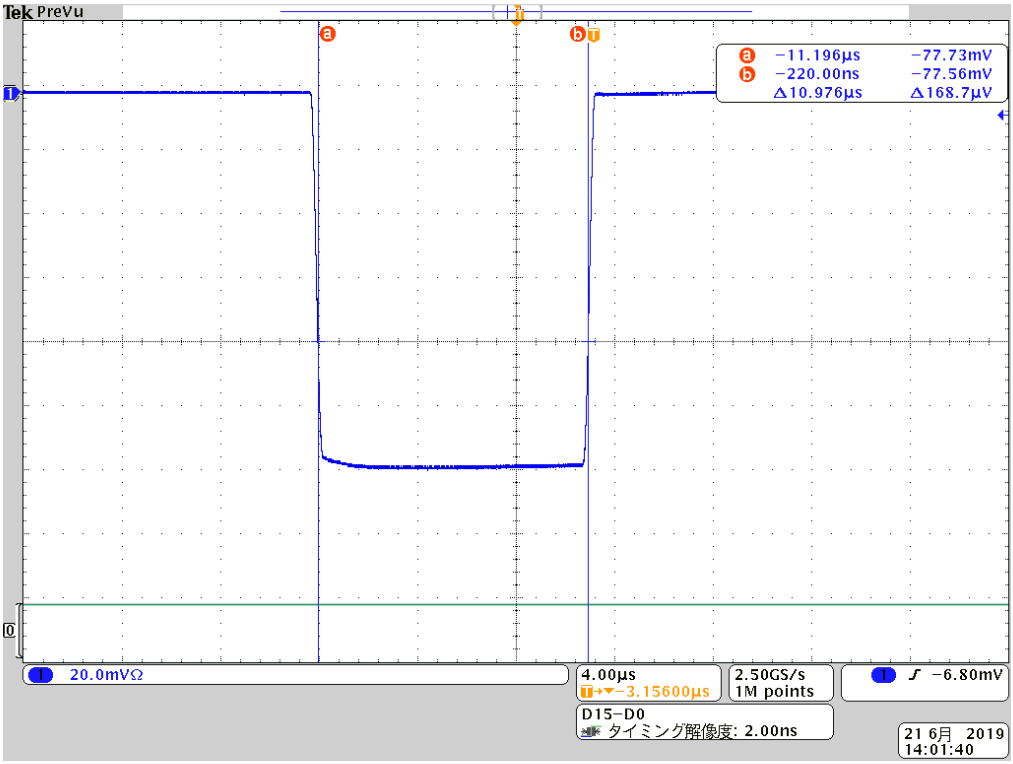


Fig. 6.49 ch3, Q0N, M1 pulse envelope

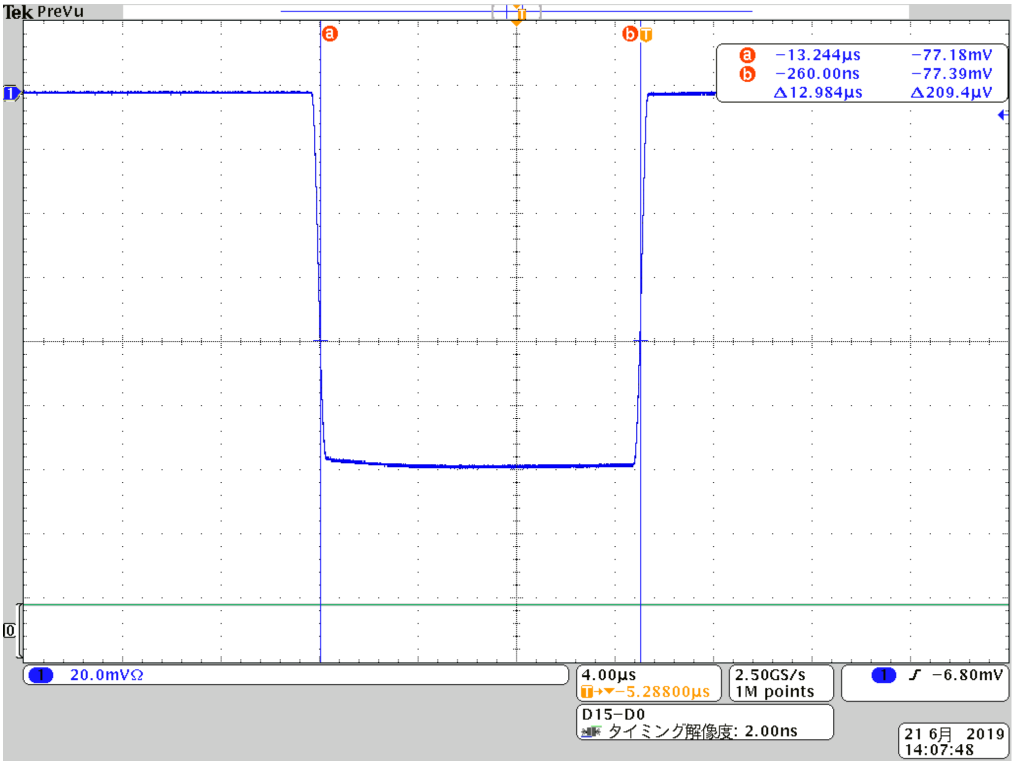


Fig. 6.50 ch3, Q0N, M2 pulse envelope

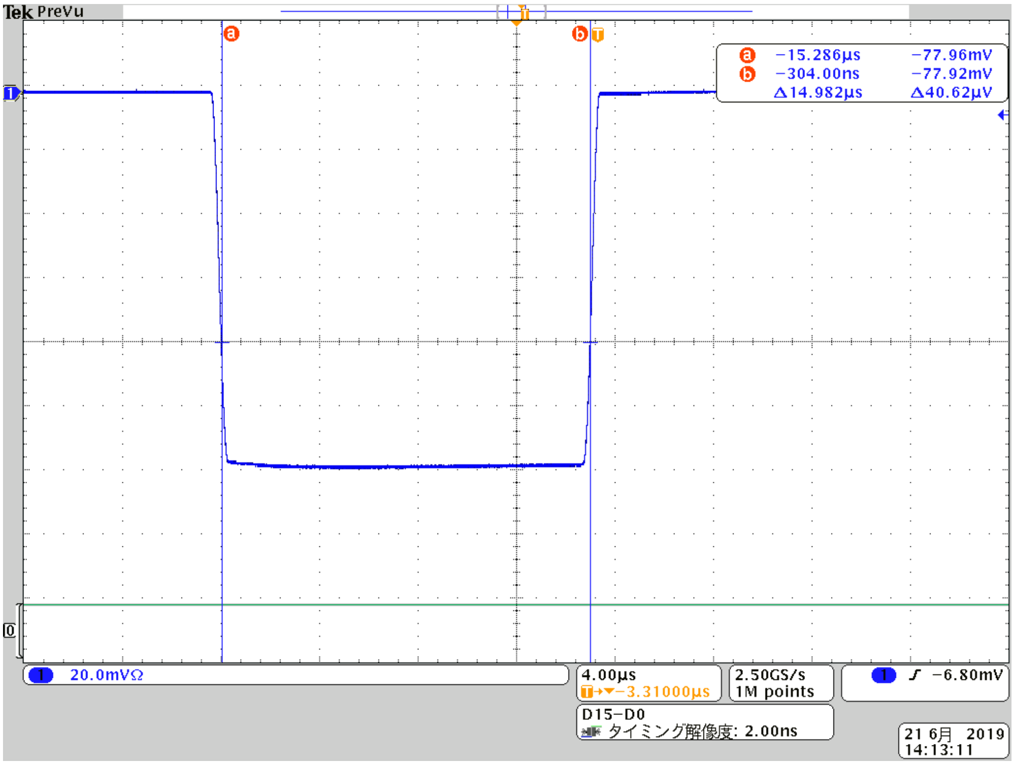


Fig. 6.51 ch3, Q0N, M3 pulse envelope

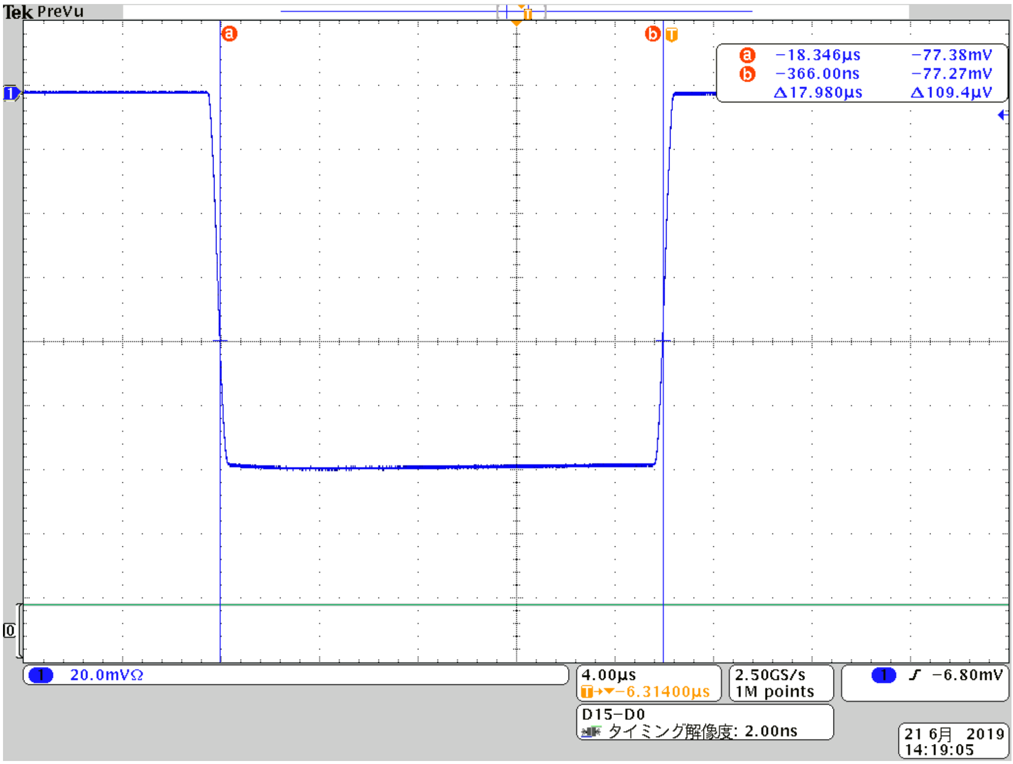


Fig. 6.52 ch3, Q0N, L1 pulse envelope

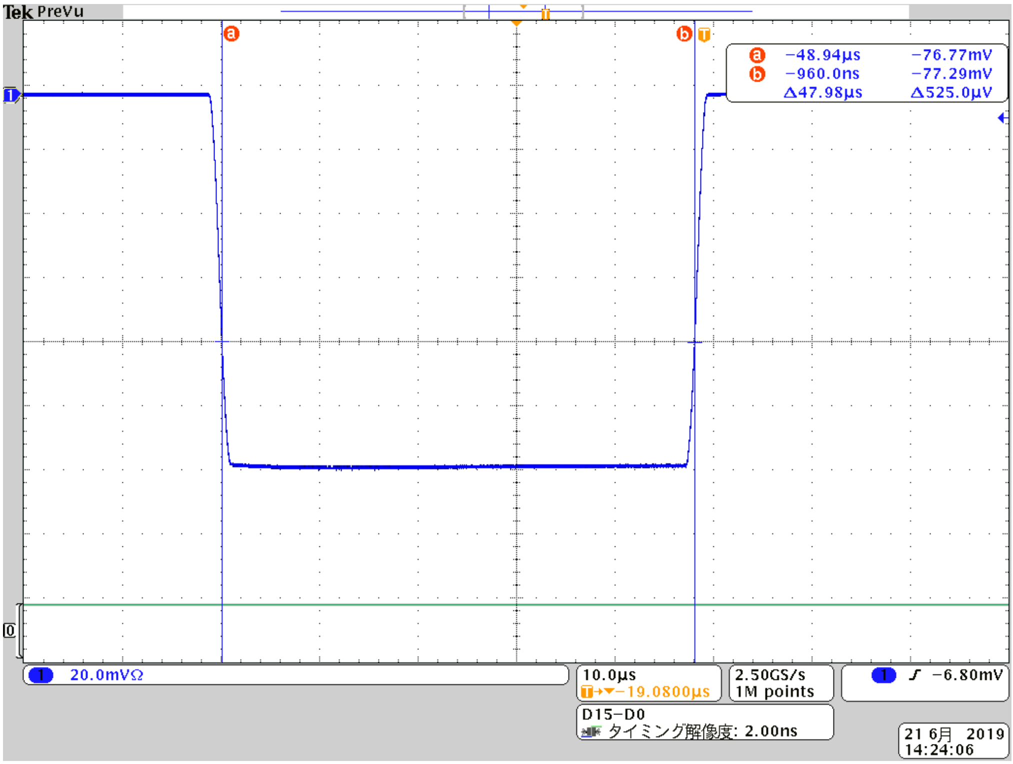


Fig. 6.53 ch3, Q0N, L2 pulse envelope

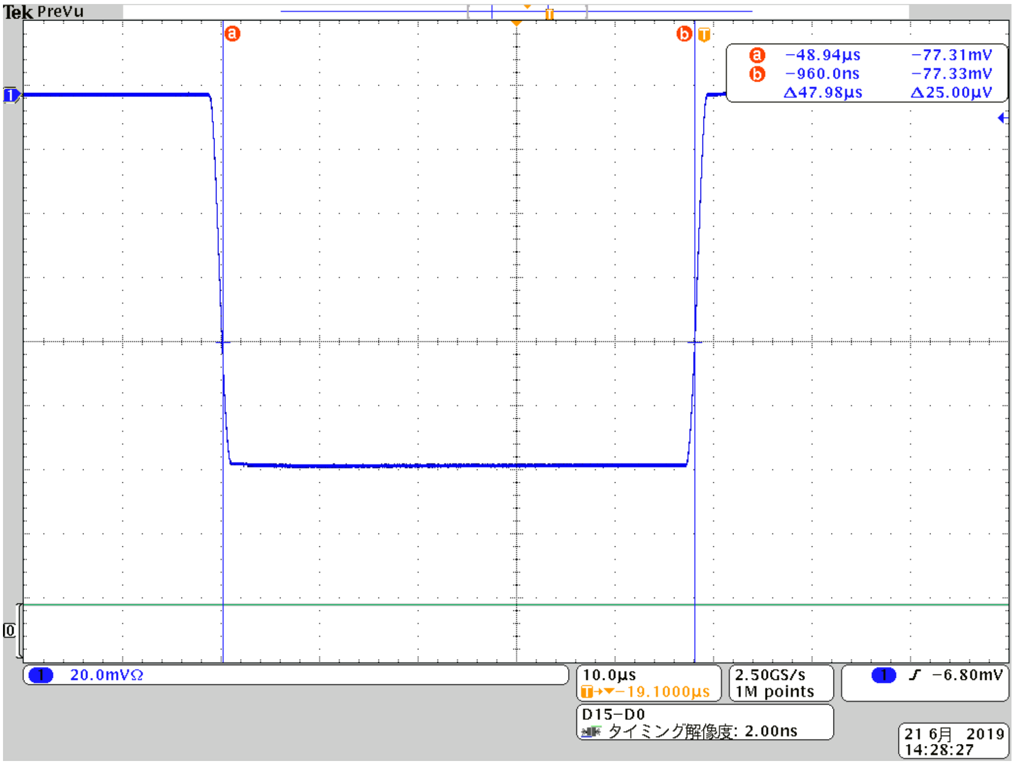


Fig. 6.54 ch3, Q0N, L2 pulse envelope

7 Spurious Emission Plots measured at Antenna Terminal

ch1, P0N

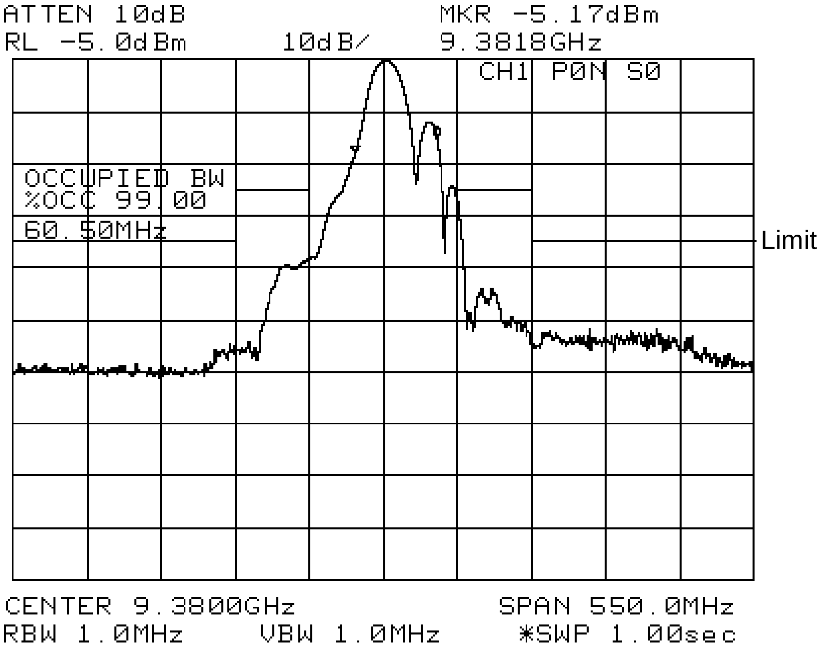


Fig. 7.1 ch1, P0N, S0 pulse

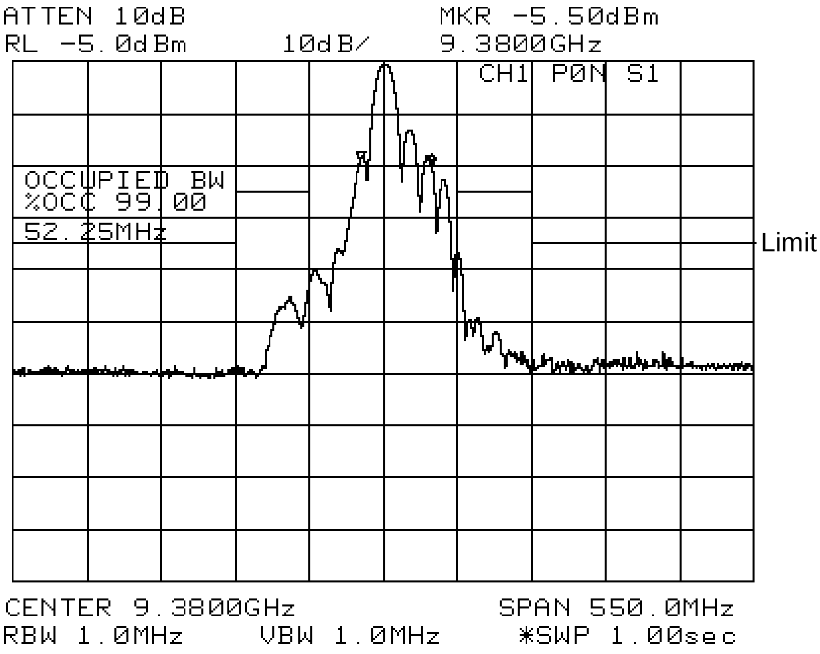


Fig. 7.2 ch1, P0N, S1 pulse

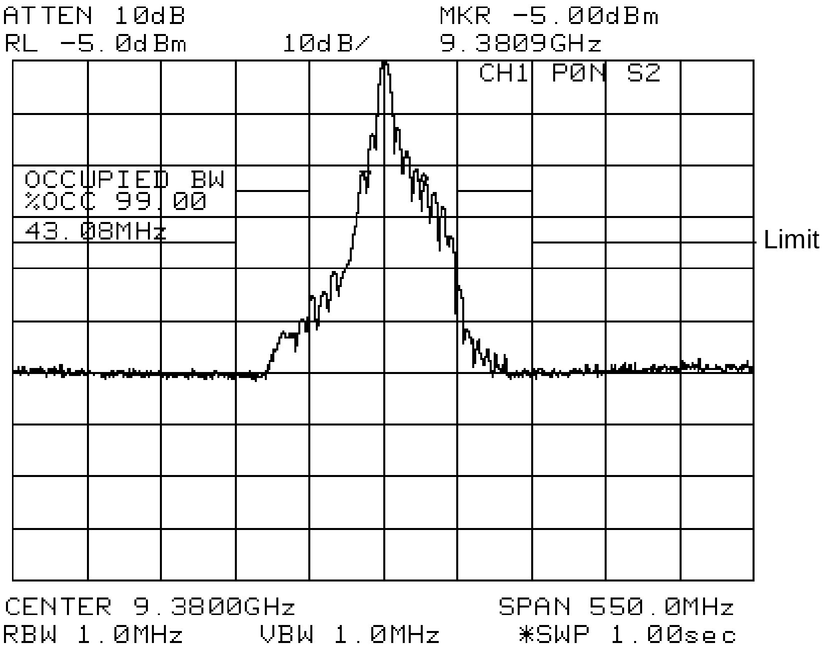


Fig. 7.3 ch1, P0N, S2 pulse

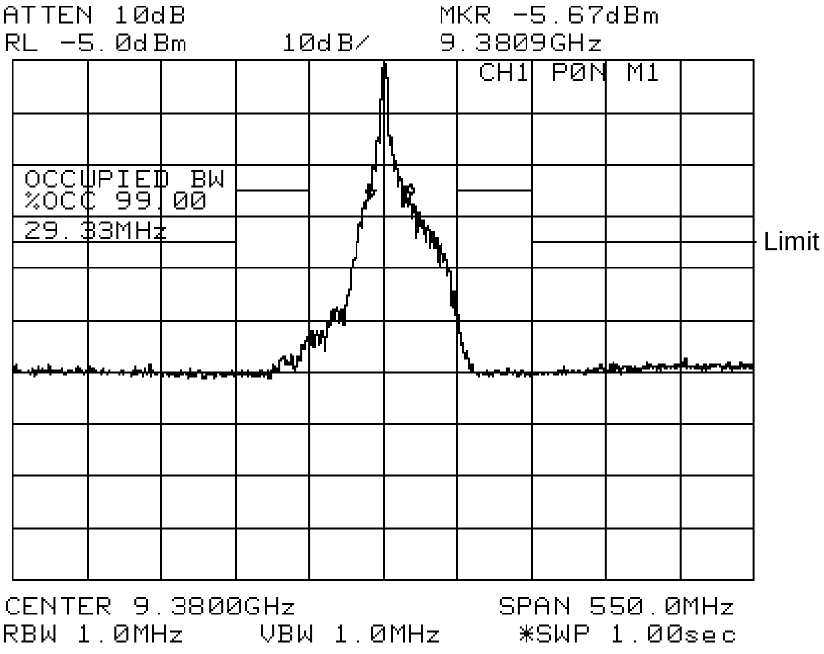


Fig. 7.4 ch1, P0N, M1 pulse

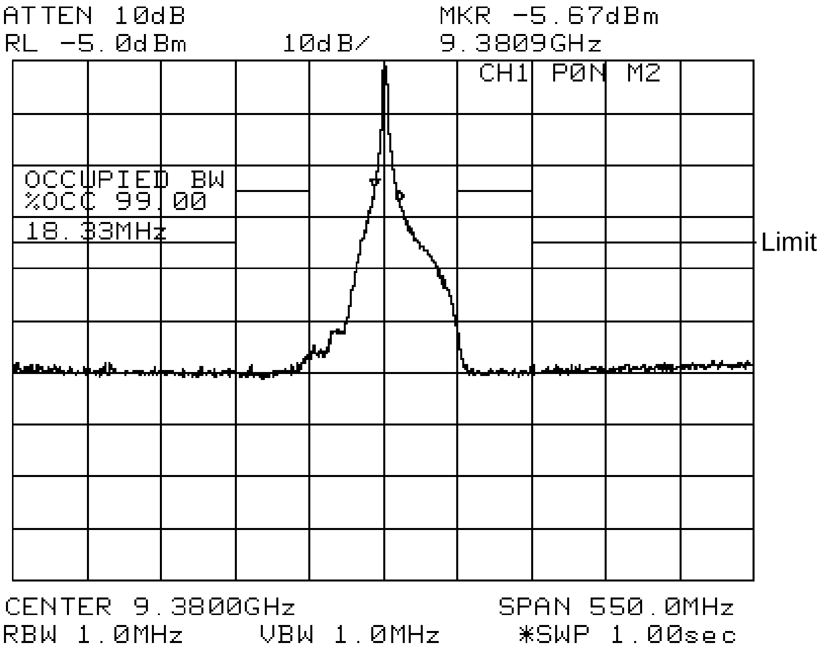


Fig. 7.5 ch1, P0N, M2 pulse

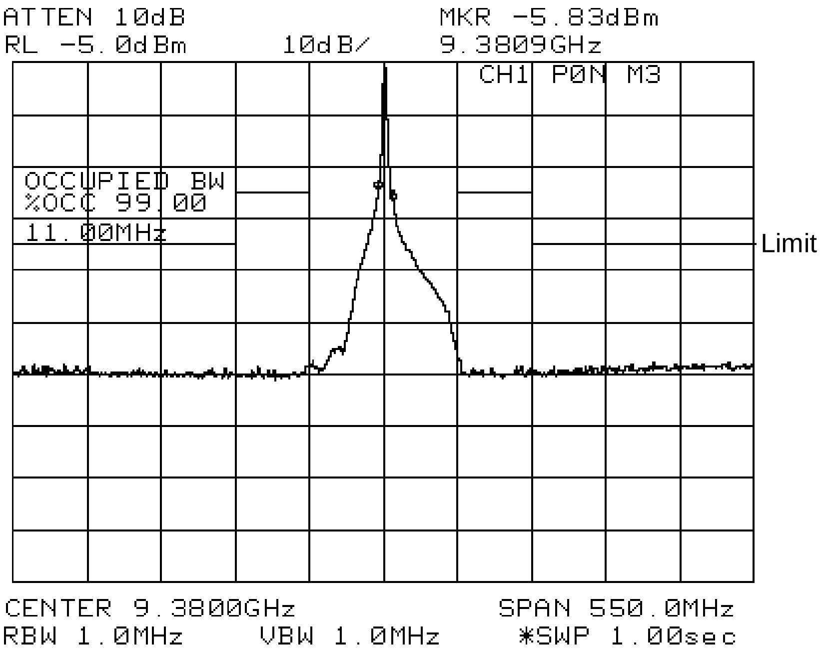


Fig. 7.6 ch1, P0N, M3 pulse

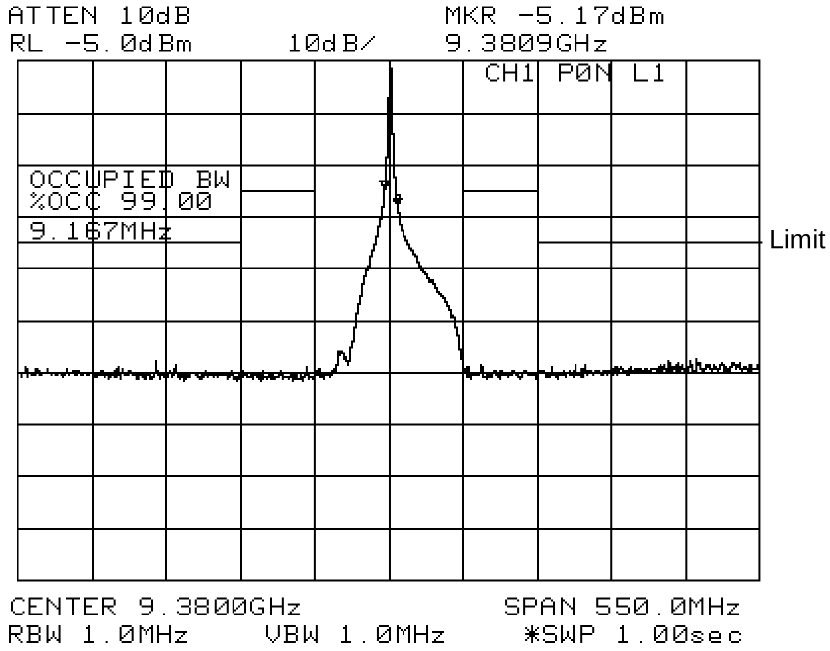


Fig. 7.7 ch1, P0N, L1 pulse

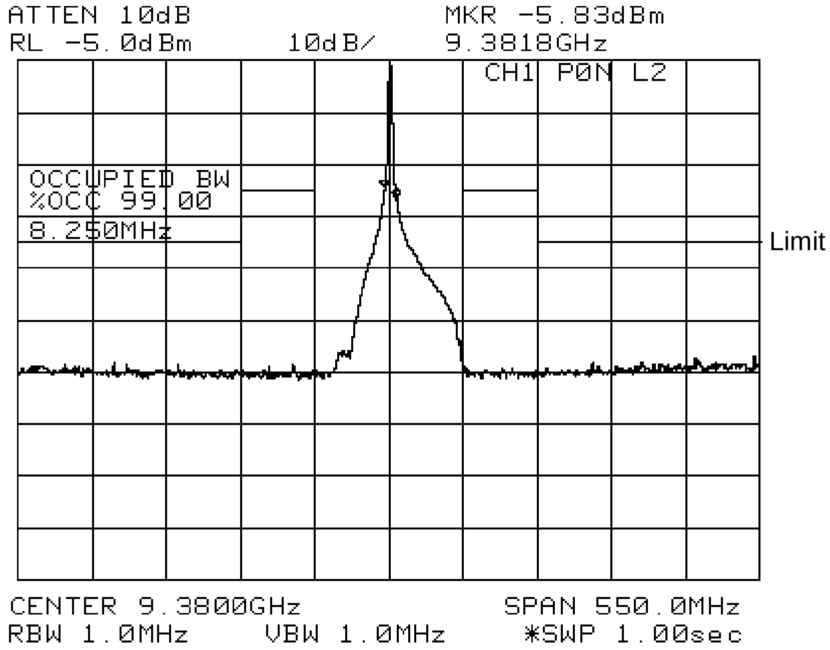


Fig. 7.8 ch1, P0N, L2 pulse

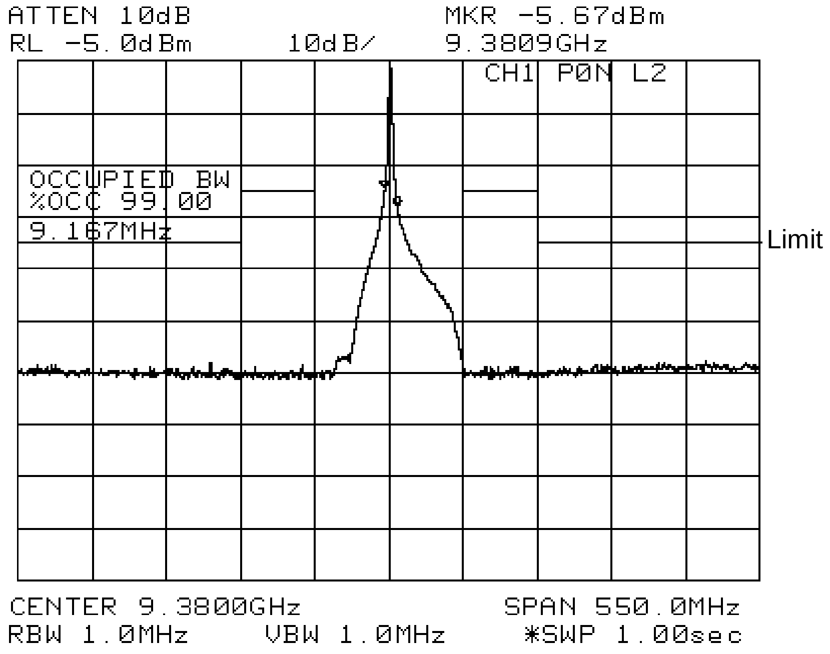


Fig. 7.9 ch1, P0N, L2 pulse

ch1, Q0N

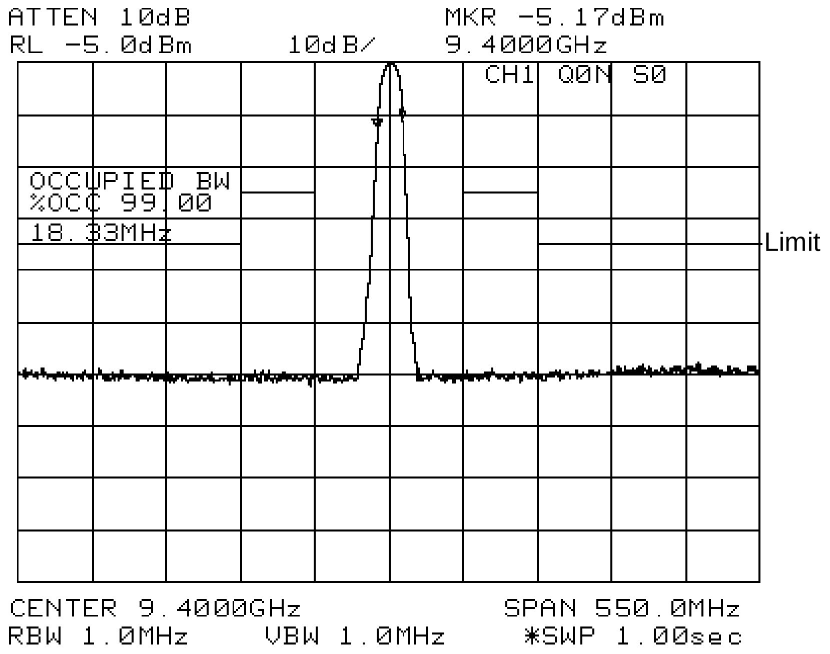


Fig. 7.10 ch1, Q0N, S0 pulse

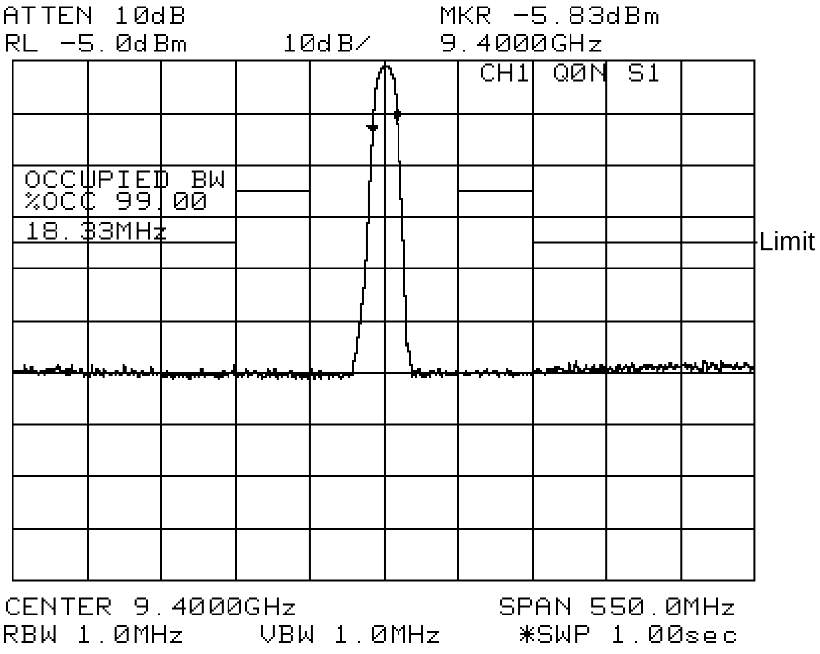


Fig. 7.11 ch1, Q0N, S1 pulse

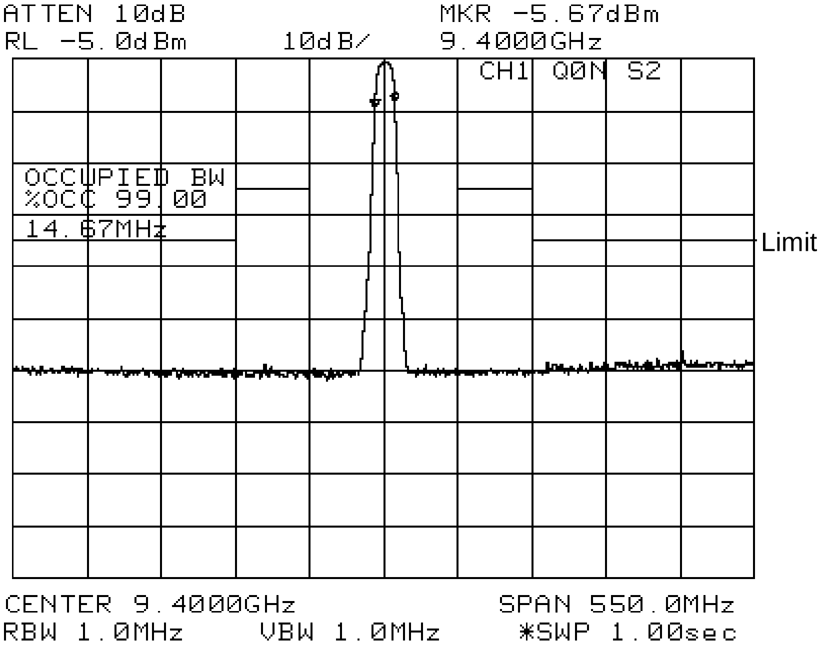


Fig. 7.12 ch1, Q0N, S2 pulse

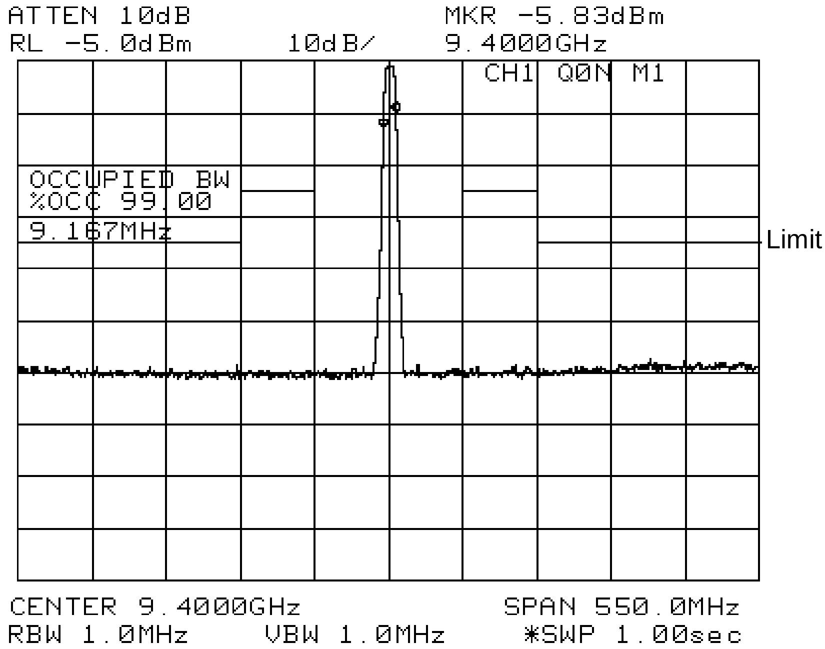


Fig. 7.13 ch1, Q0N, M1 pulse

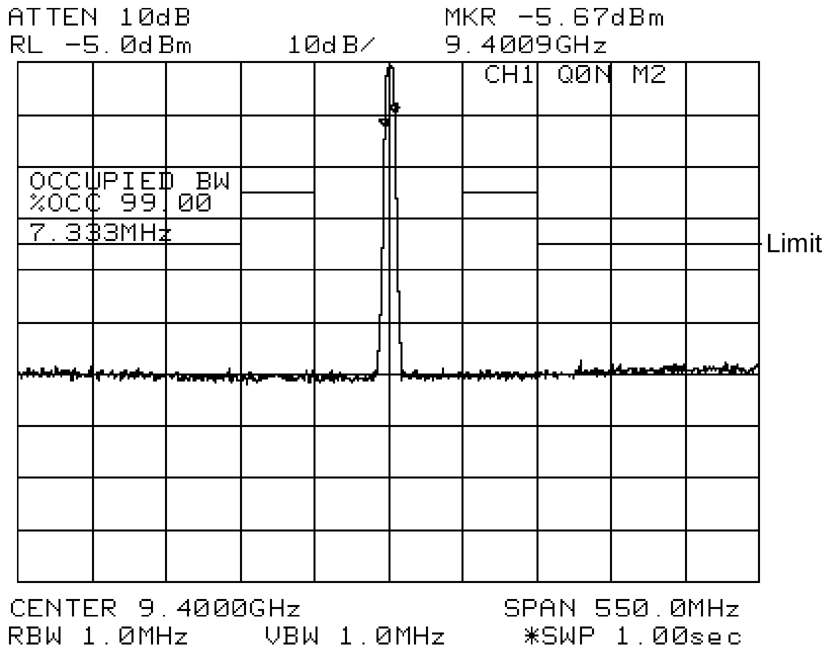


Fig. 7.14 ch1, Q0N, M2 pulse

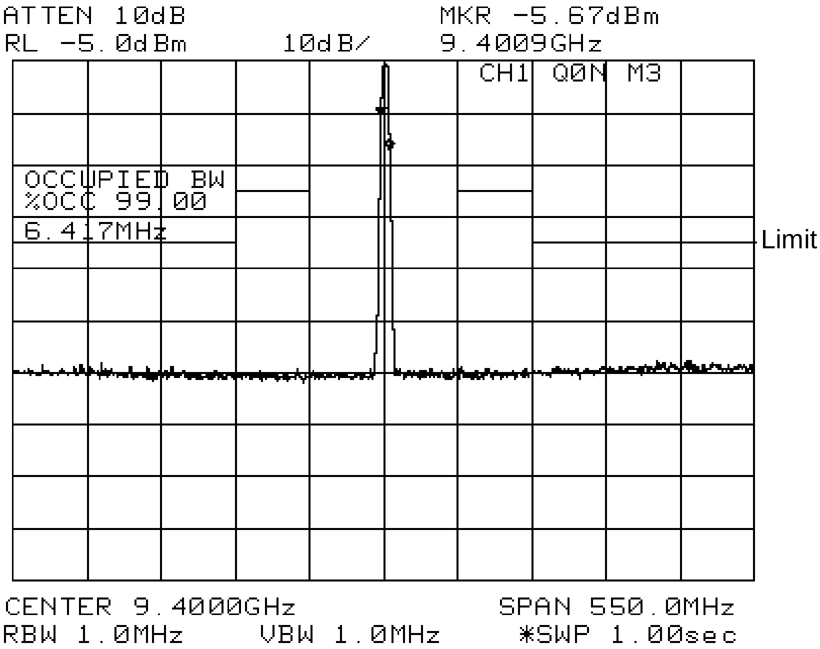


Fig. 7.15 ch1, Q0N, M3 pulse

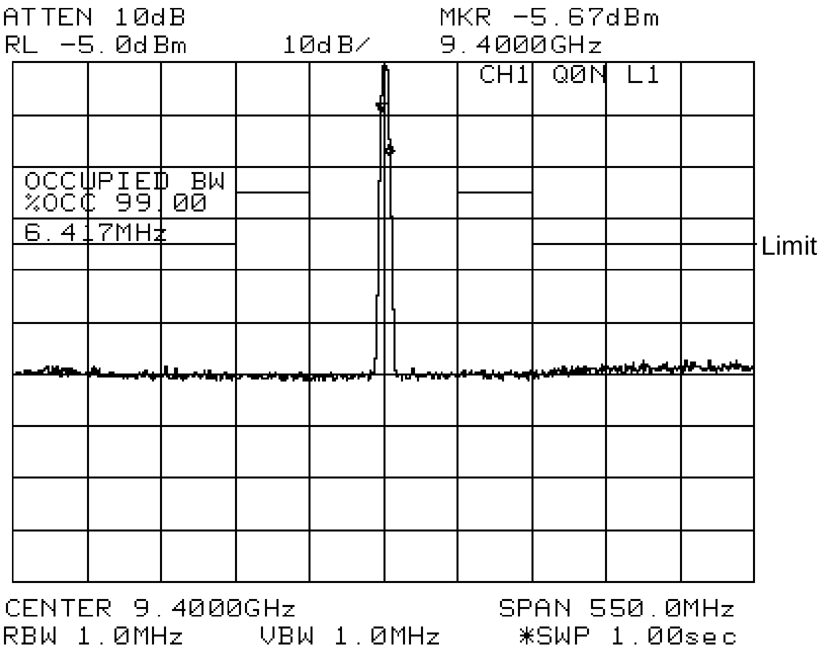


Fig. 7.16 ch1, Q0N, L1 pulse

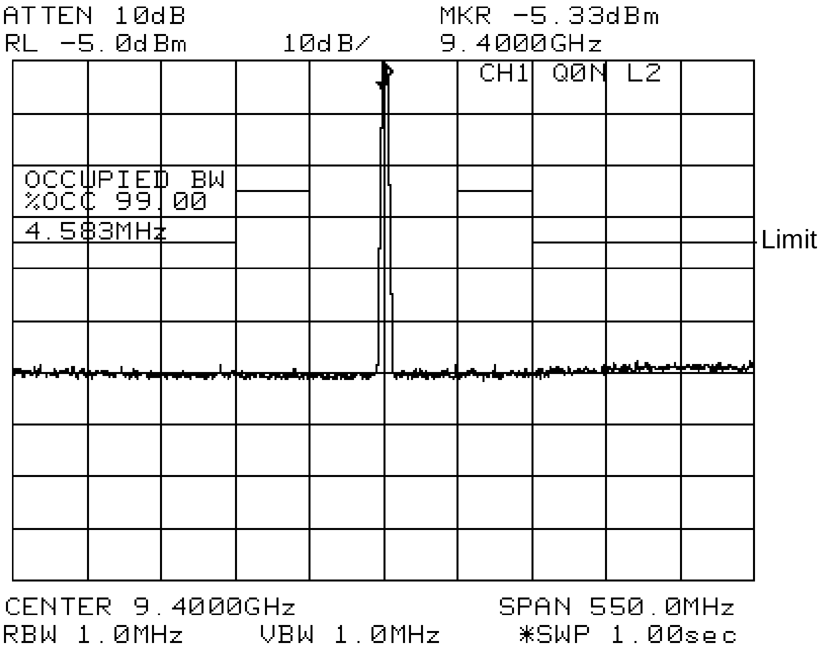


Fig. 7.17 ch1, Q0N, L2 pulse

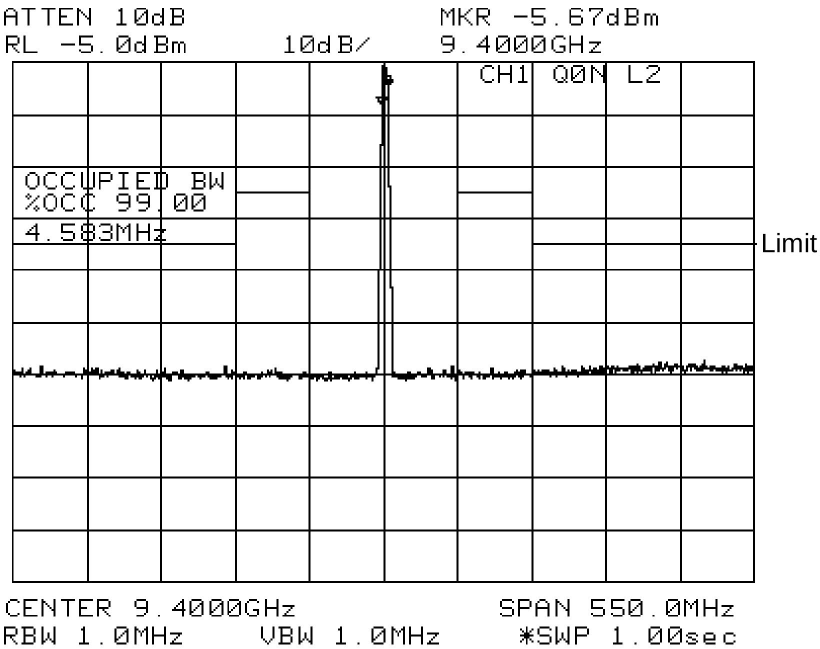


Fig. 7.18 ch1, Q0N, L2 pulse

ch2, P0N

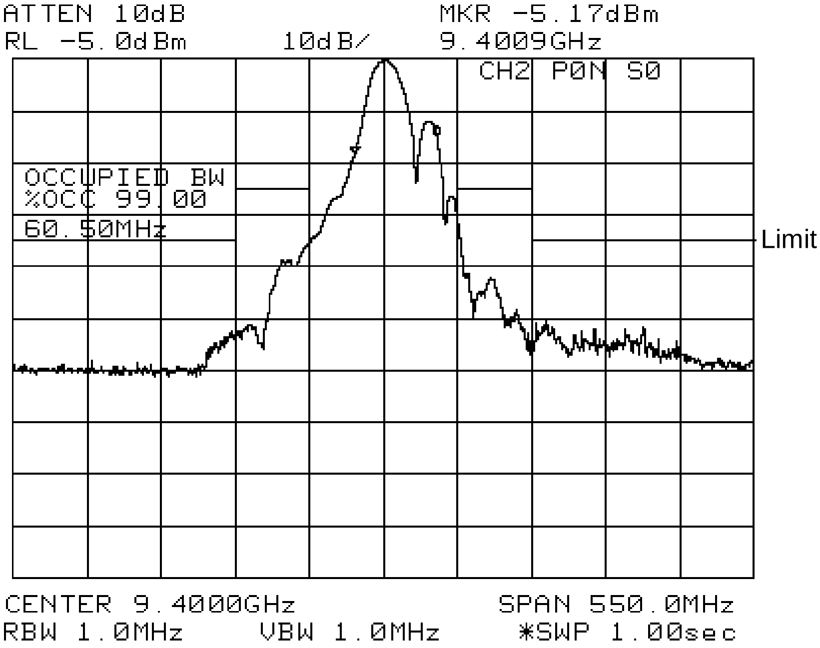


Fig. 7.19 ch2, P0N, S0 pulse

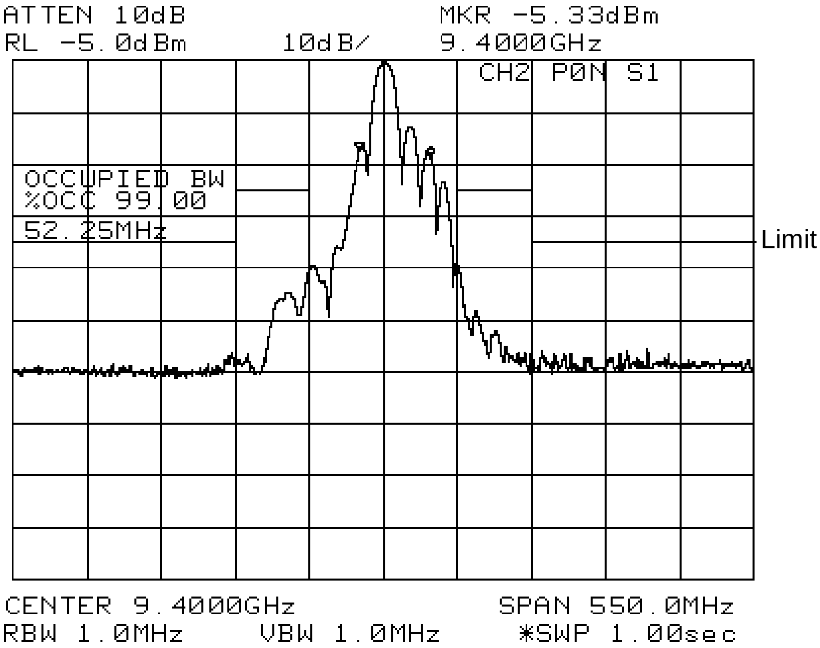


Fig. 7.20 ch2, P0N, S1 pulse

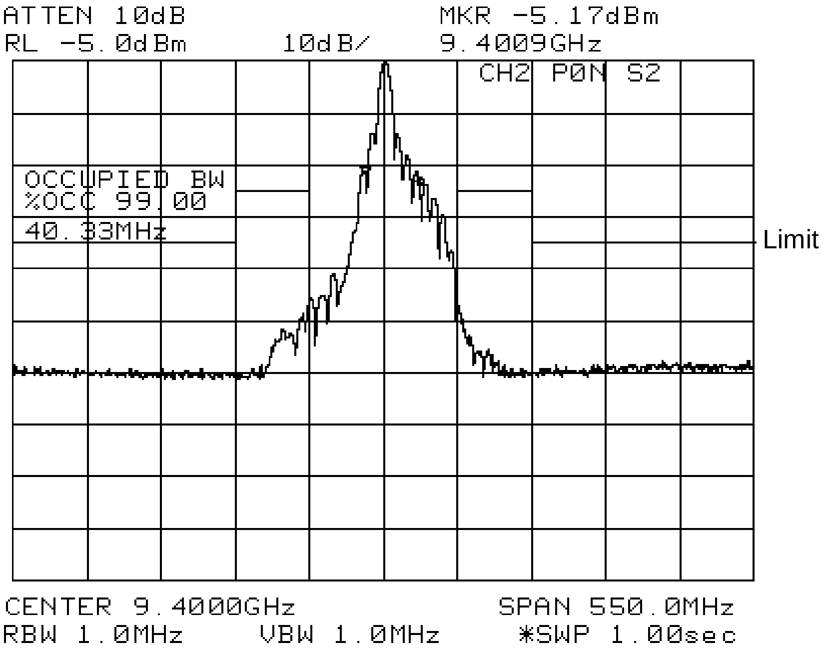


Fig. 7.21 ch2, P0N, S2 pulse

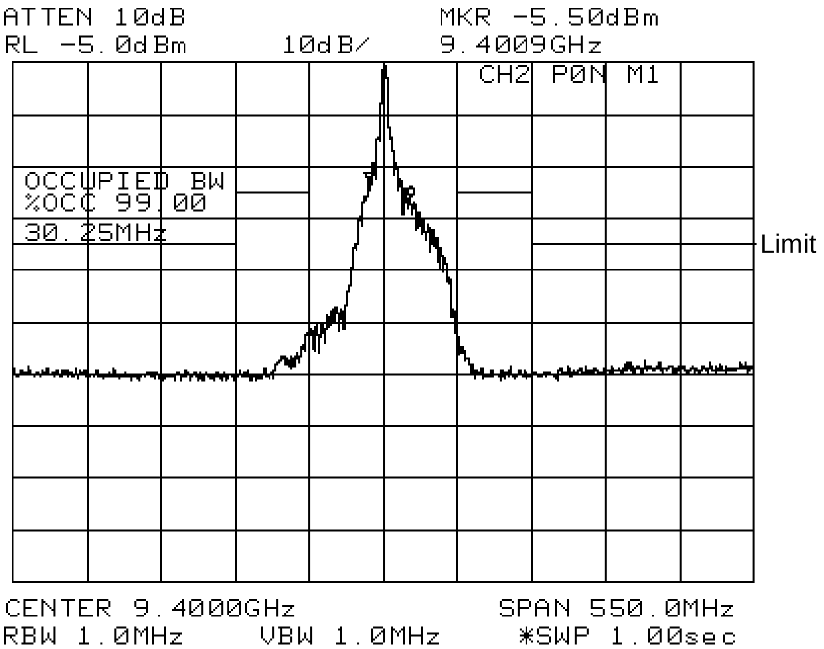


Fig. 7.22 ch2, P0N, M1 pulse

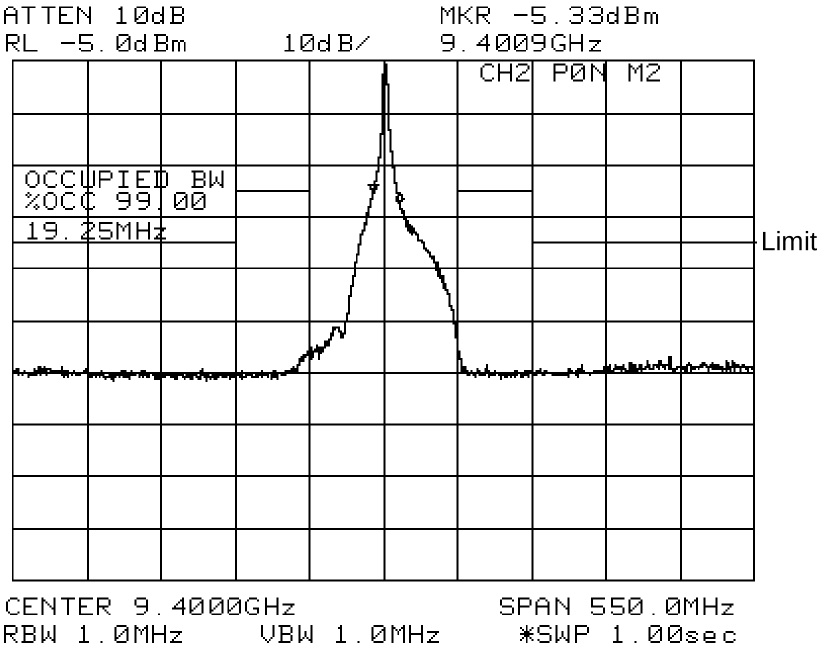


Fig. 7.23 ch2, P0N, M2 pulse

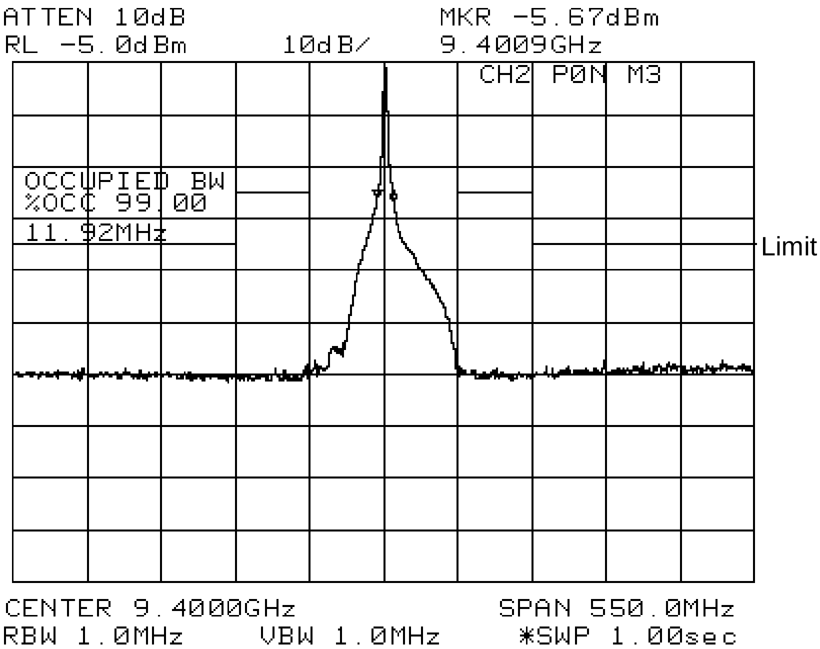


Fig. 7.24 ch2, P0N, M3 pulse

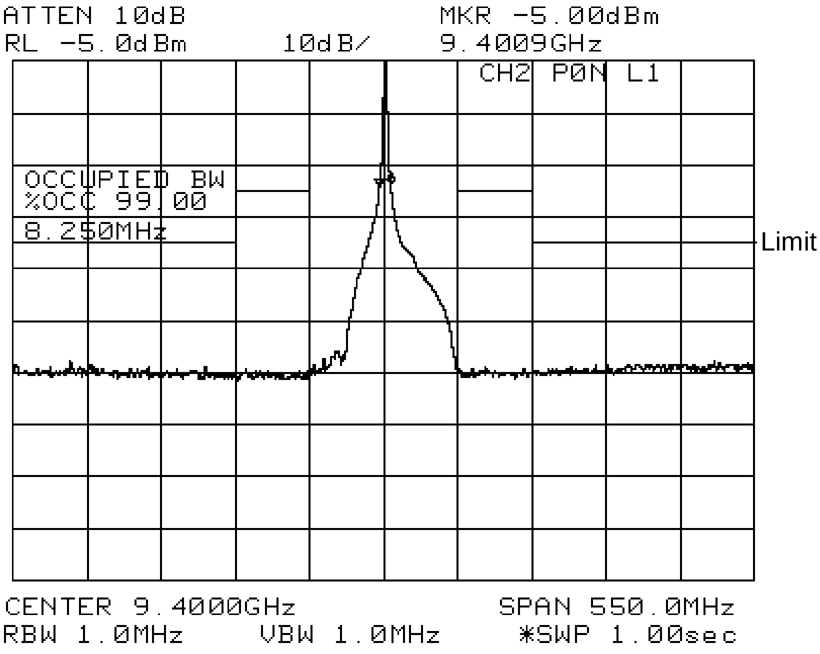


Fig. 7.25 ch2, P0N, L1 pulse

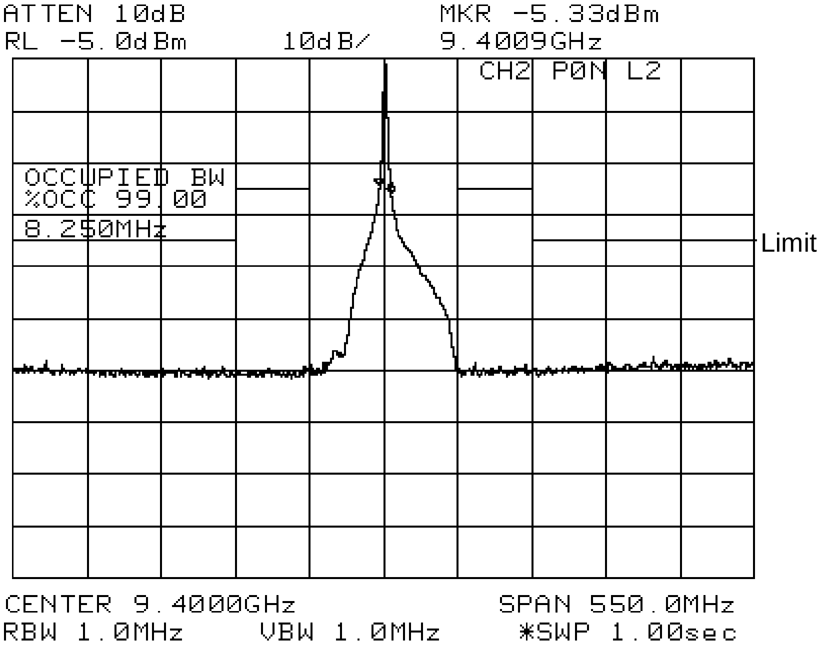


Fig. 7.26 ch2, P0N, L2 pulse

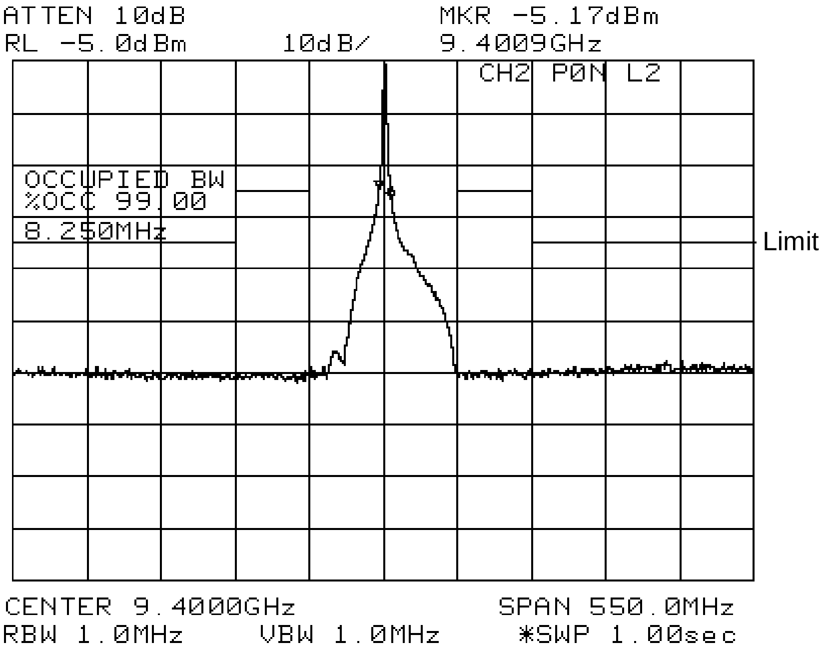


Fig. 7.27 ch2, P0N, L2 pulse

ch2, Q0N

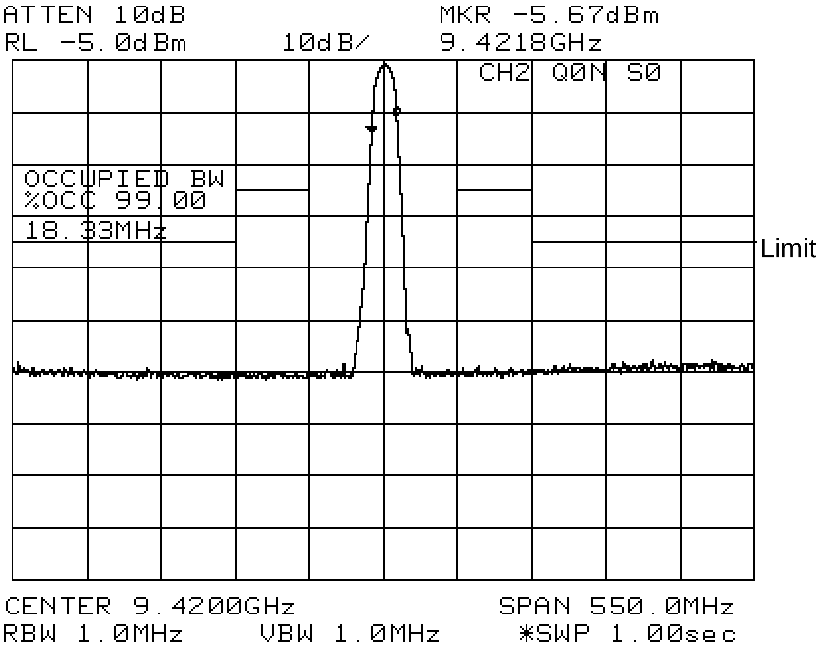


Fig. 7.28 ch2, Q0N, S0 pulse

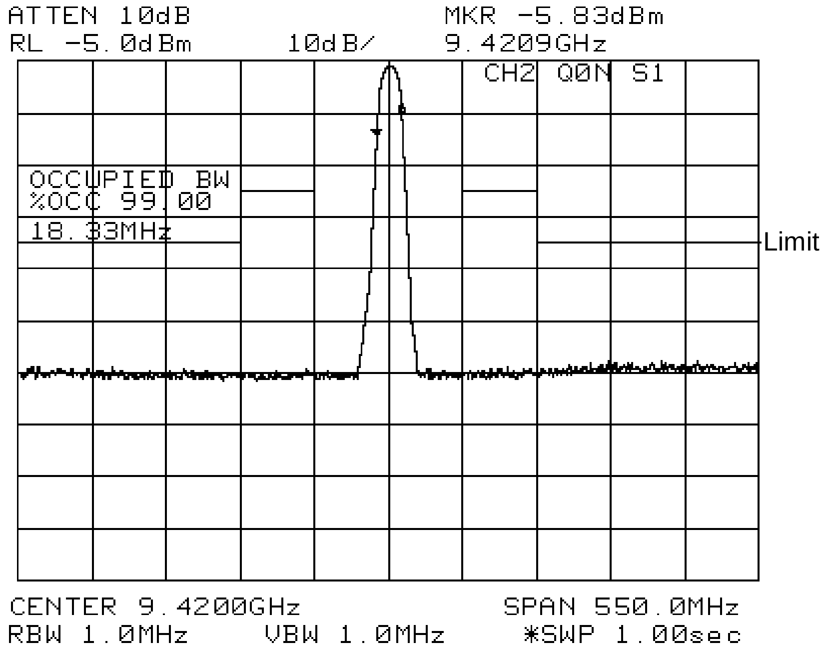


Fig. 7.29 ch2, Q0N, S1 pulse

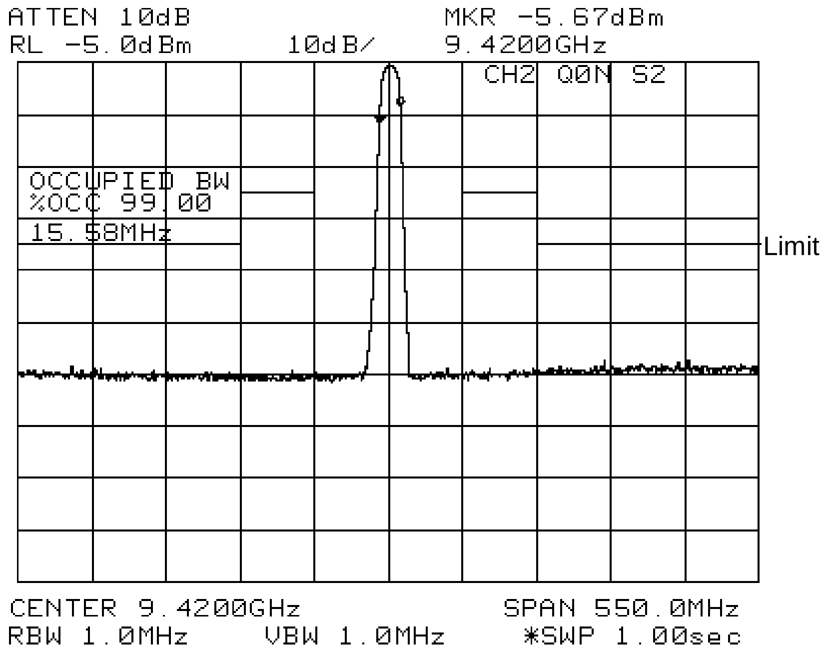


Fig. 7.30 ch2, Q0N, S2 pulse

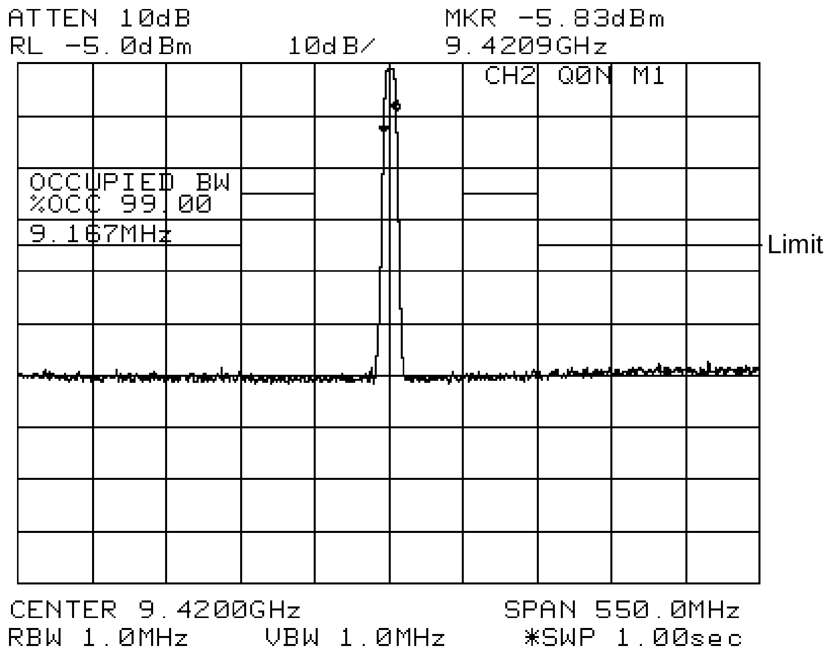


Fig. 7.31 ch2, Q0N, M1 pulse

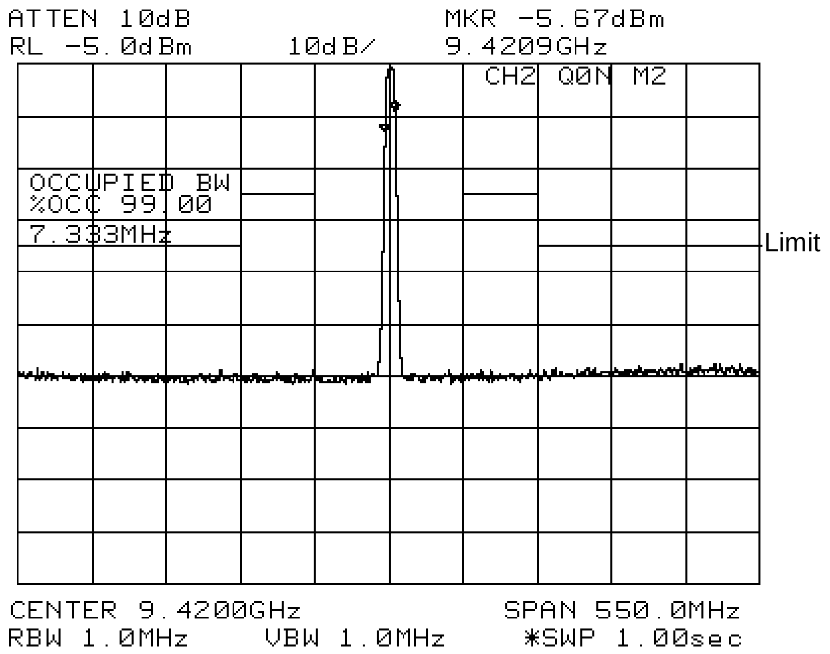


Fig. 7.32 ch2, Q0N, M2 pulse

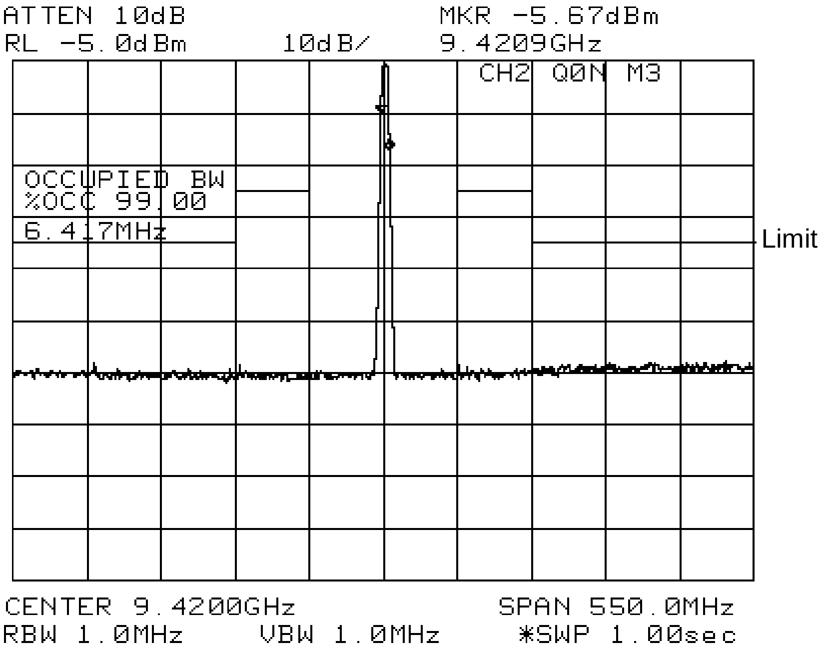


Fig. 7.33 ch2, Q0N, M3 pulse

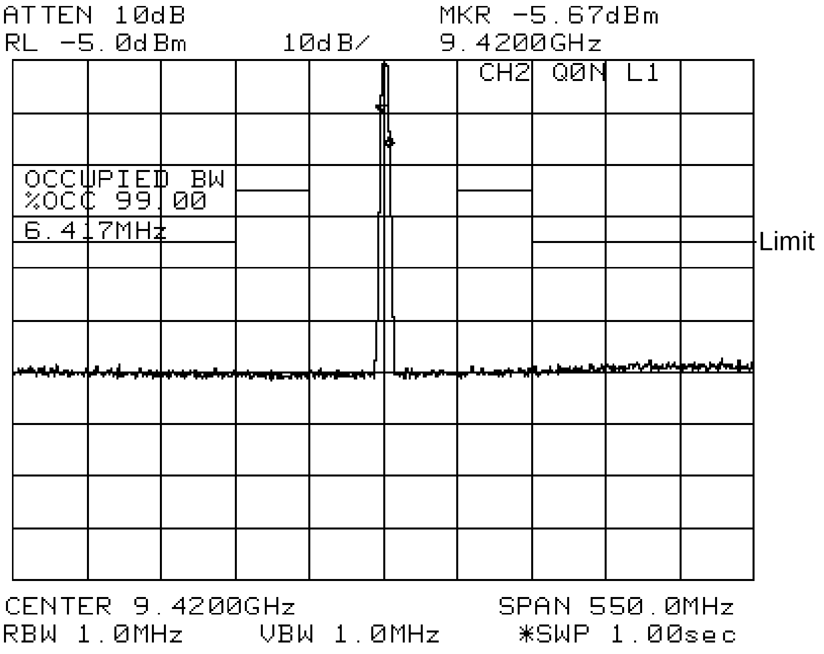


Fig. 7.34 ch2, Q0N, L1 pulse

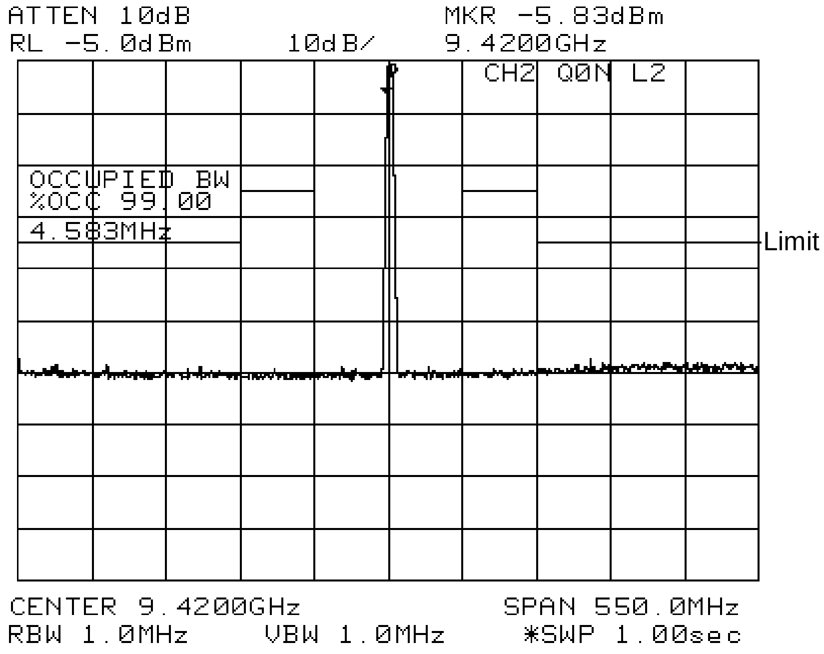


Fig. 7.35 ch2, Q0N, L2 pulse

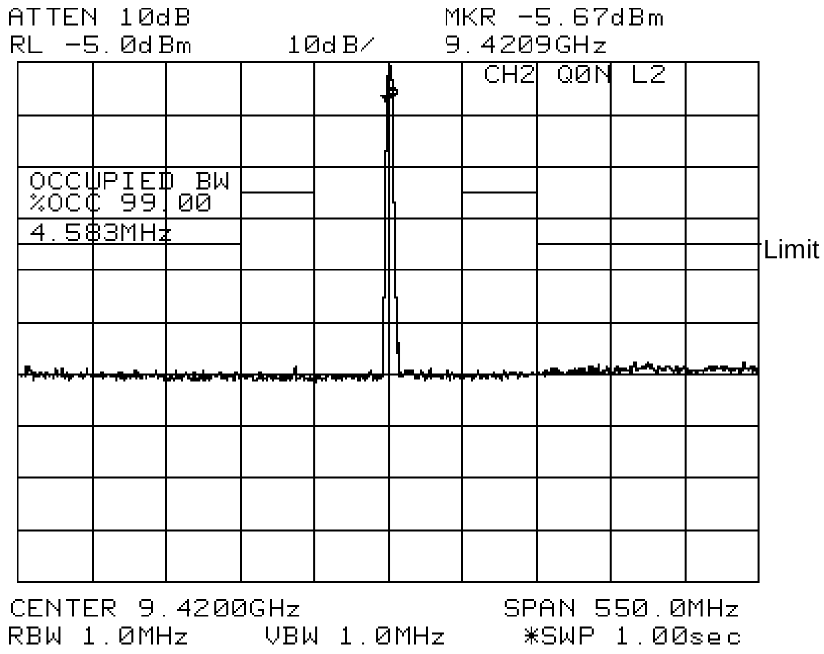


Fig. 7.36 ch1, P0N, L2 pulse

ch3, P0N

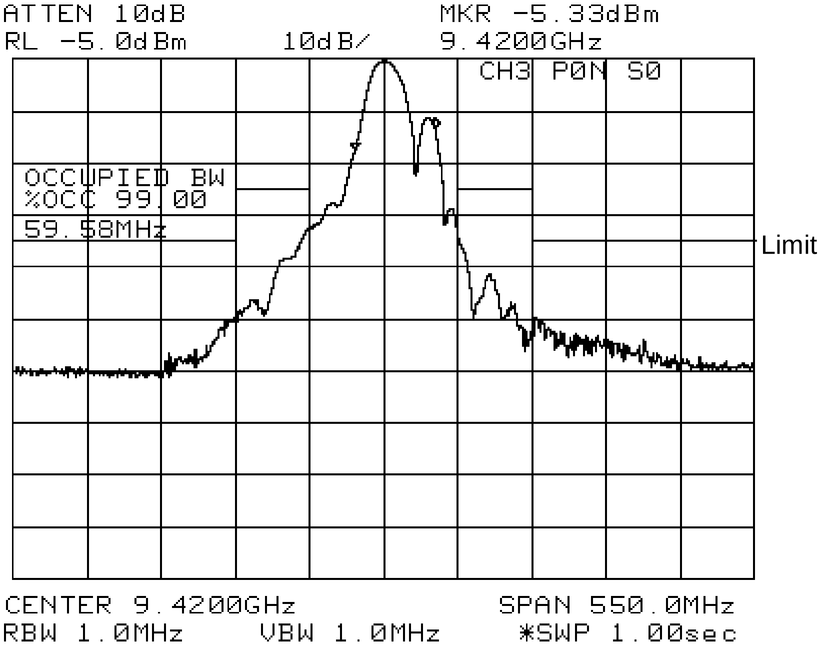


Fig. 7.37 ch3, P0N, S0 pulse

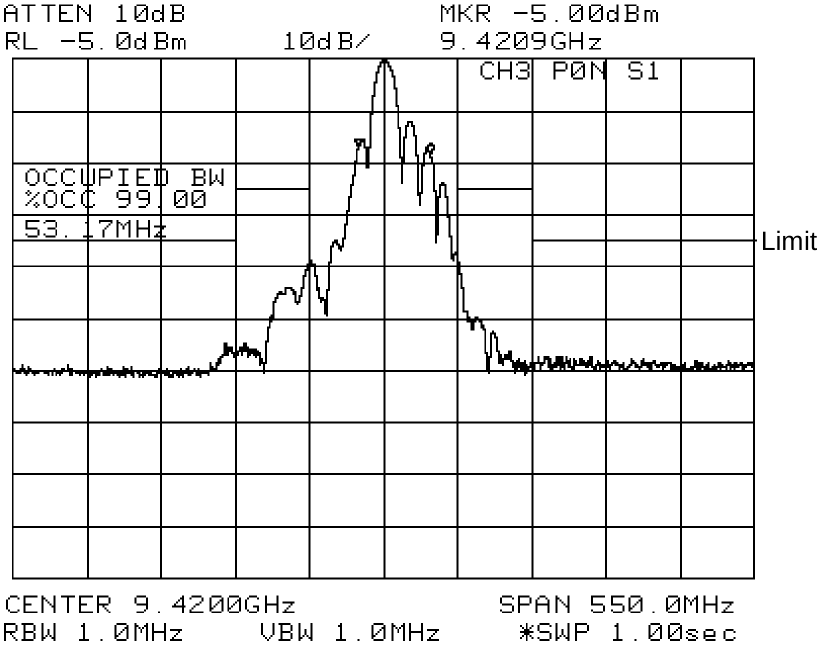


Fig. 7.38 ch3, P0N, S1 pulse

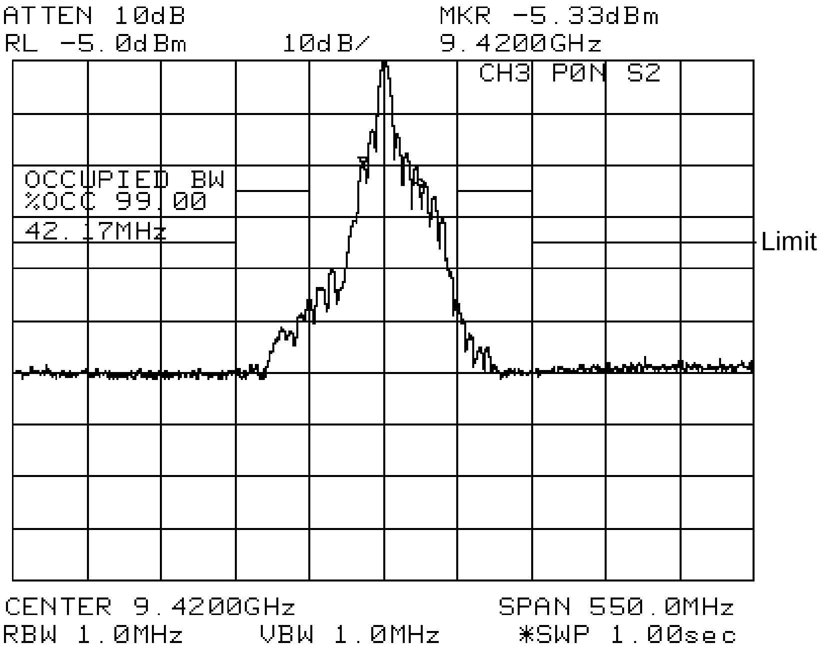


Fig. 7.39 ch3, P0N, S2 pulse

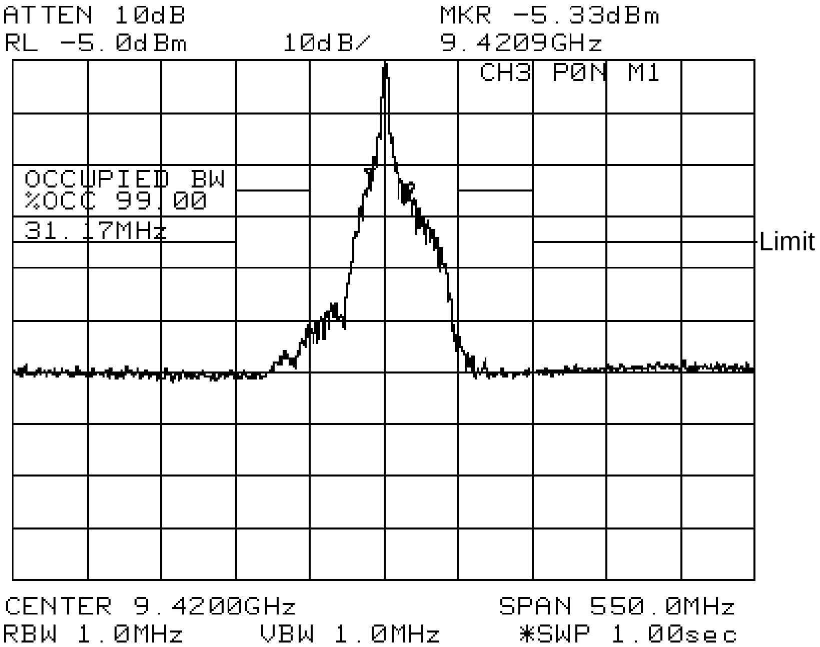


Fig. 7.40 ch3, P0N, M1 pulse

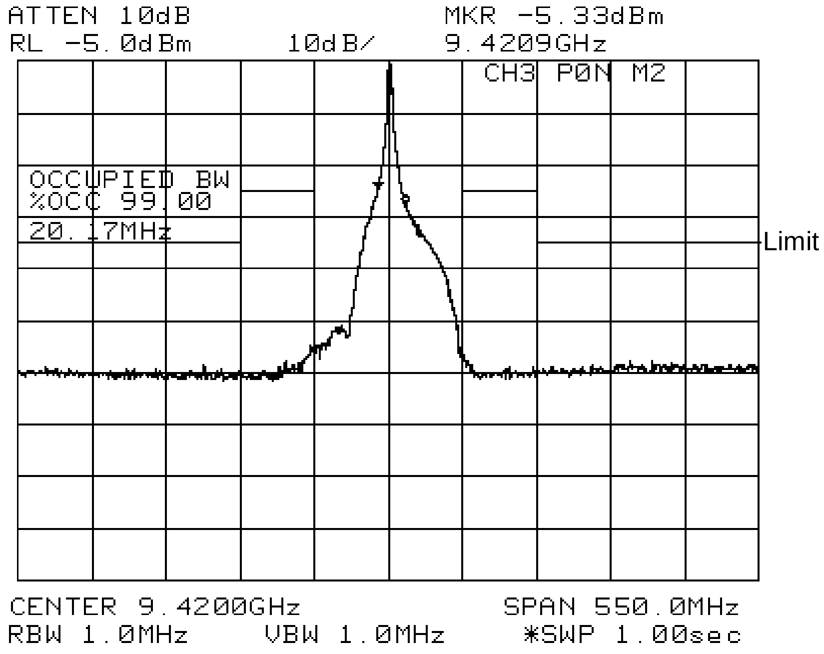


Fig. 7.41 ch3, P0N, M2 pulse

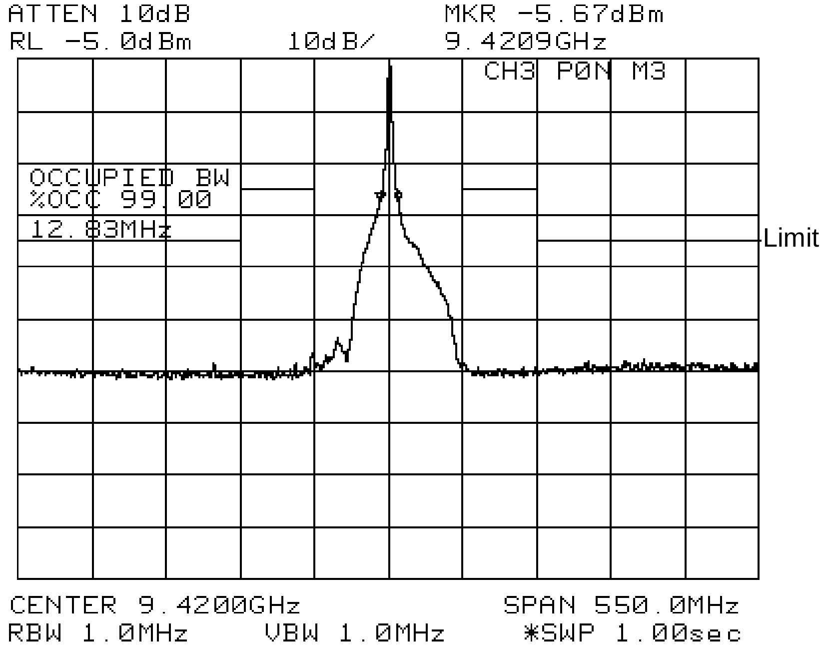


Fig. 7.42 ch3, P0N, M3 pulse

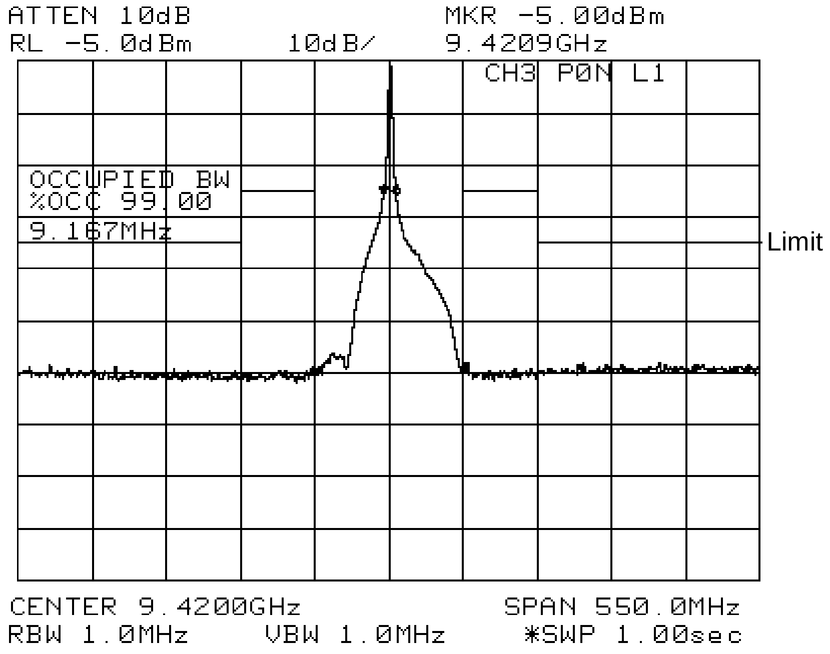


Fig. 7.43 ch3, P0N, L1 pulse

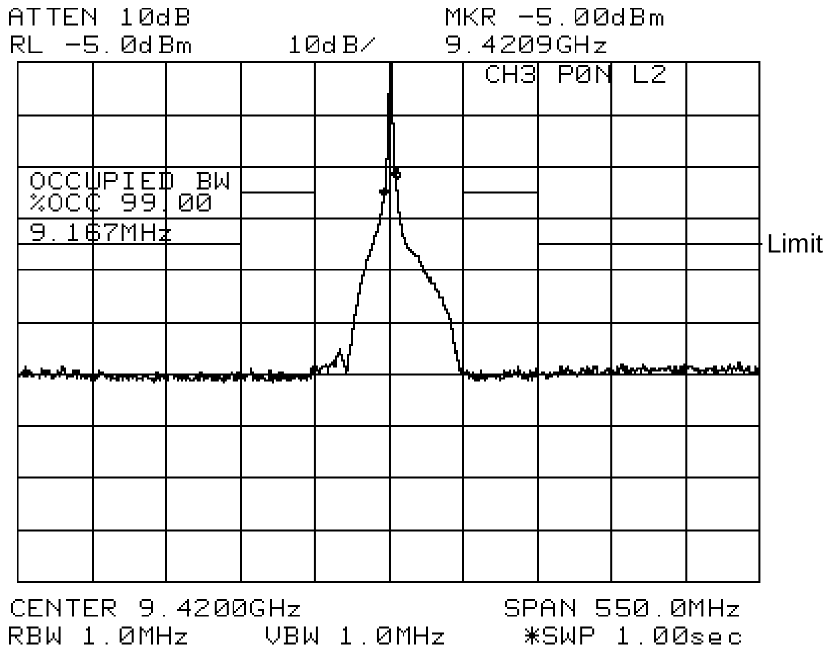


Fig. 7.44 ch3, P0N, L2 pulse

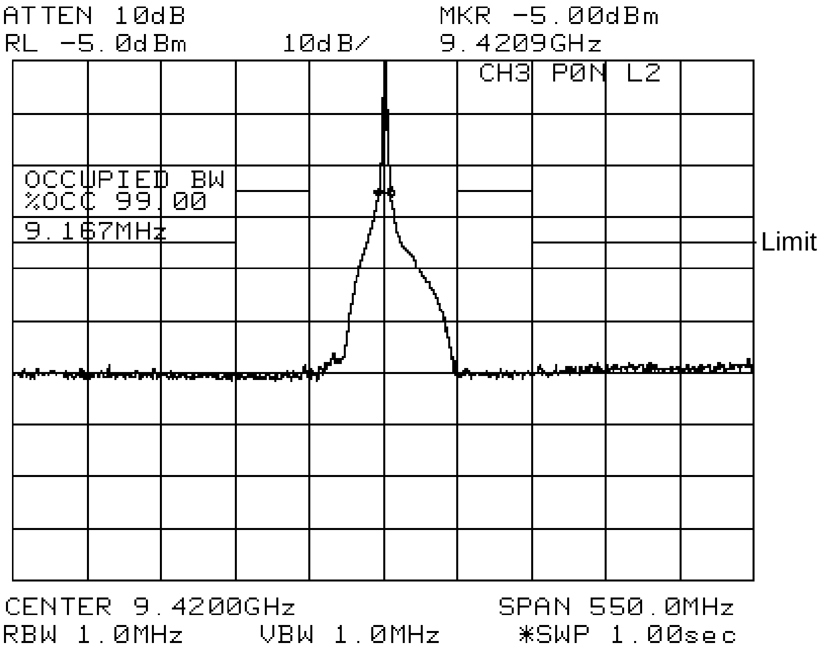


Fig. 7.45 ch3, P0N, L2 pulse

ch3, Q0N

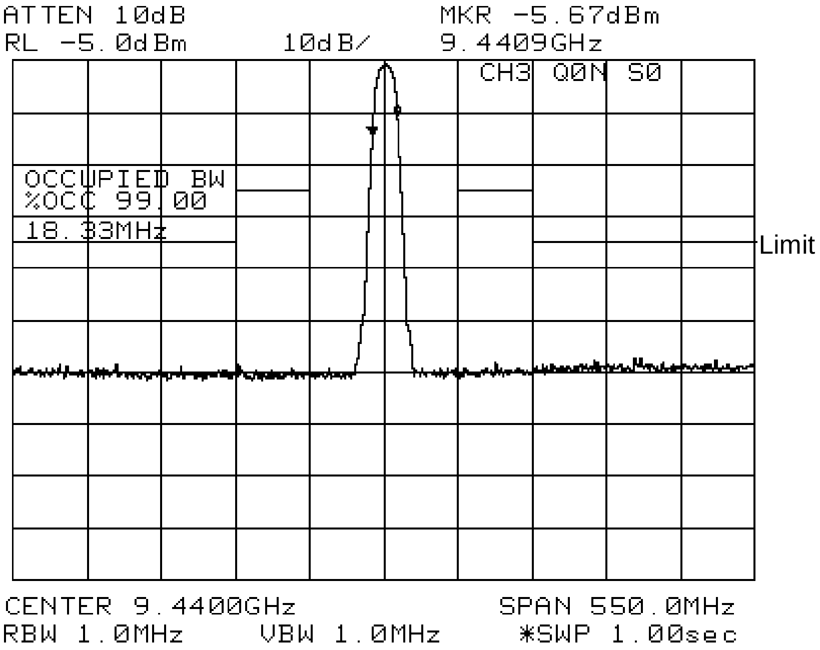


Fig. 7.46 ch3, Q0N, S0 pulse

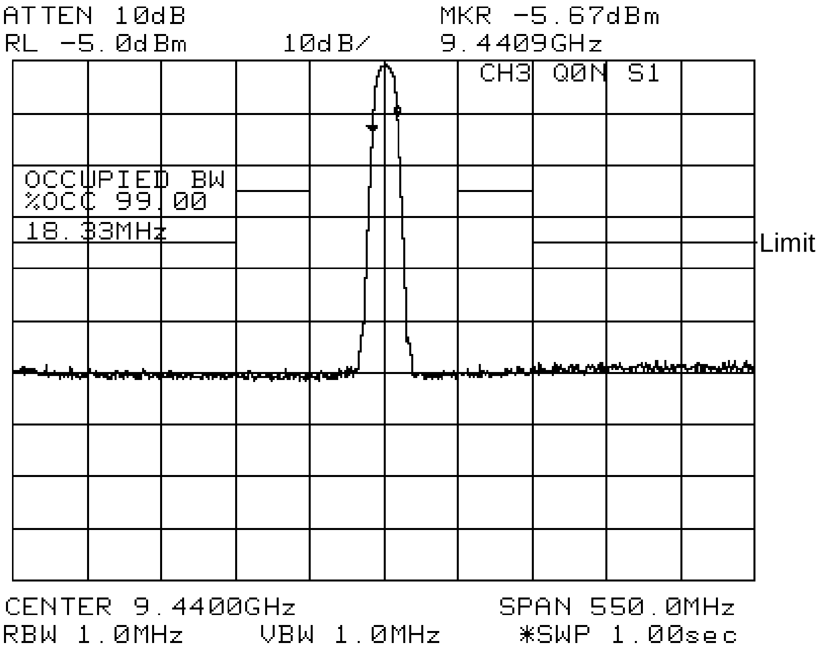


Fig. 7.47 ch3, Q0N, S1 pulse

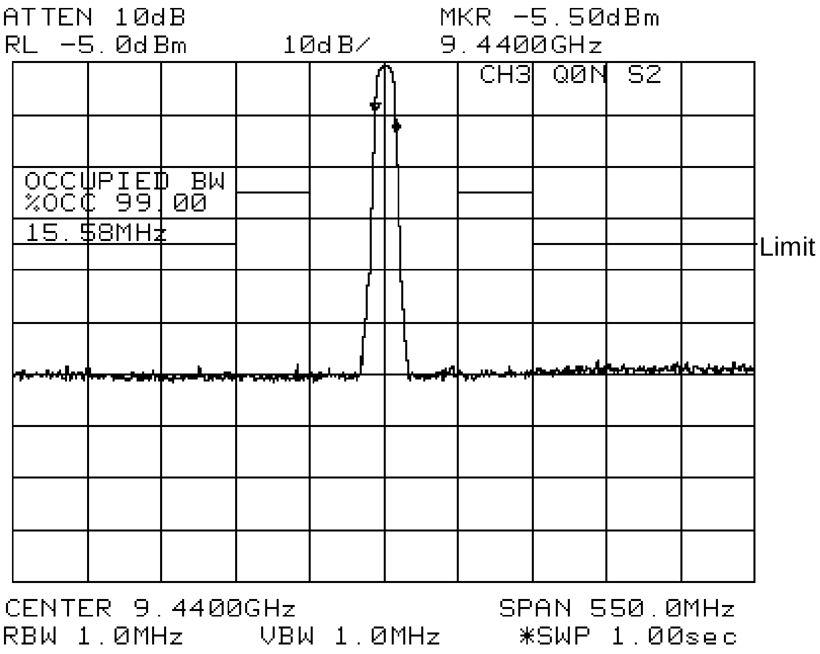


Fig. 7.48 ch3, Q0N, S2 pulse

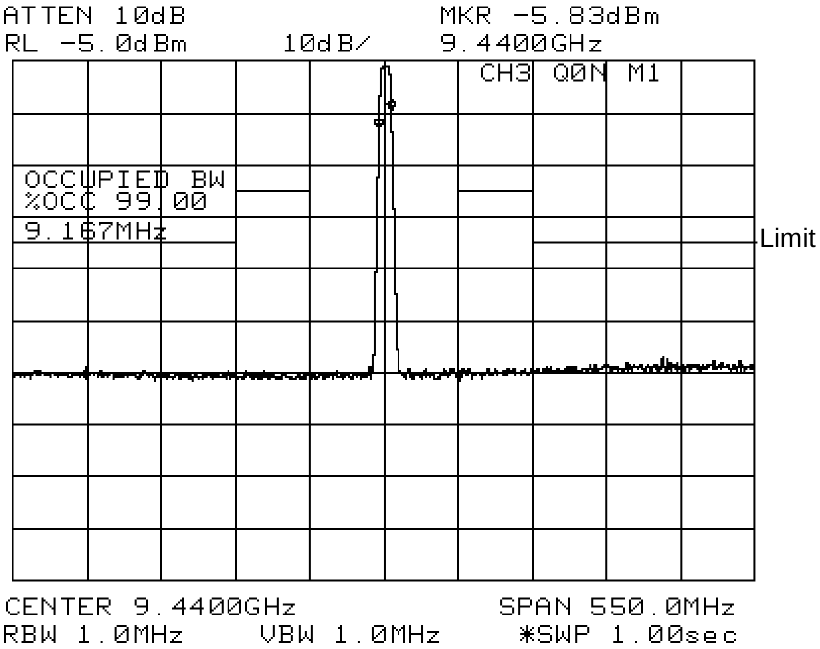


Fig. 7.49 ch3, Q0N, M1 pulse

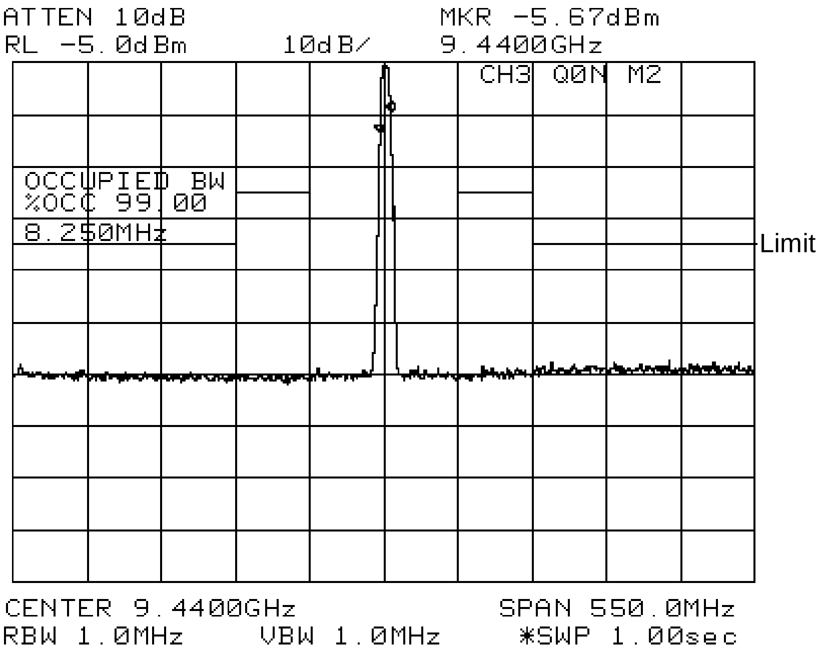


Fig. 7.50 ch3, Q0N, M2 pulse

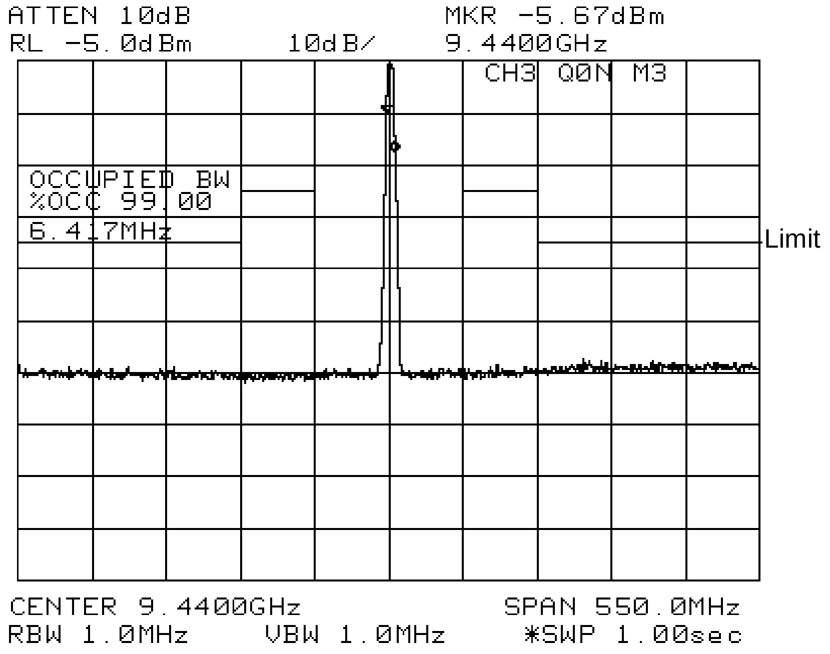


Fig. 7.51 ch3, Q0N, M3 pulse

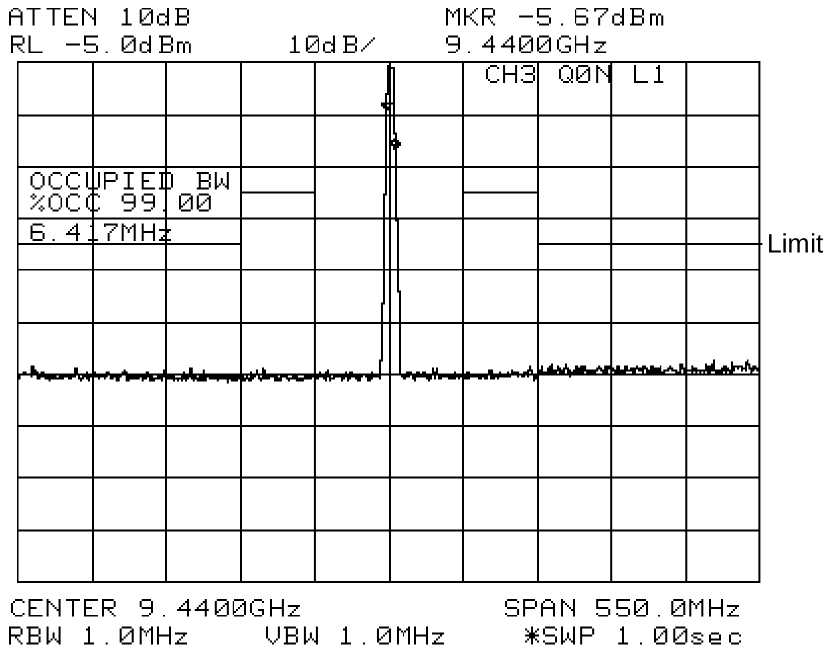


Fig. 7.52 ch3, Q0N, L1 pulse

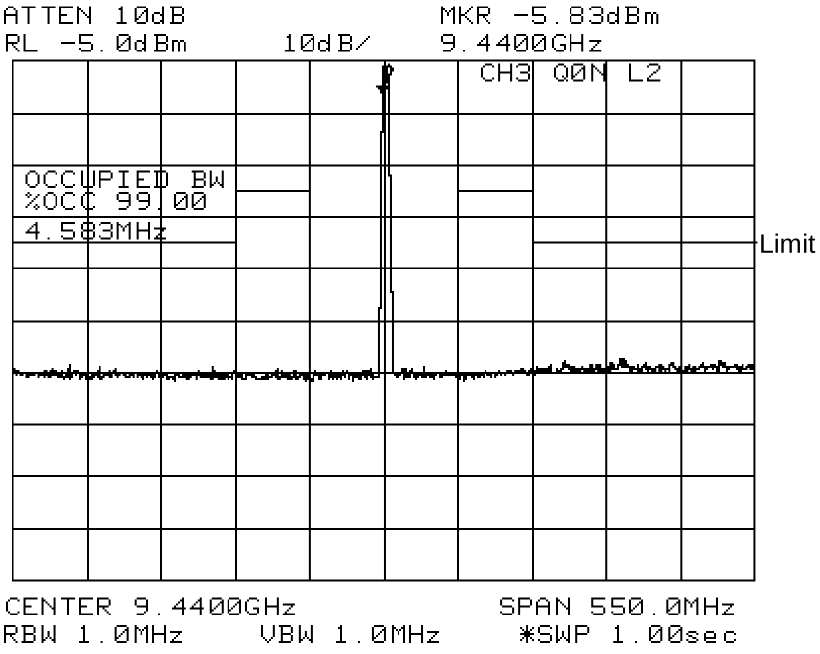


Fig. 7.53 ch3, Q0N, L2 pulse

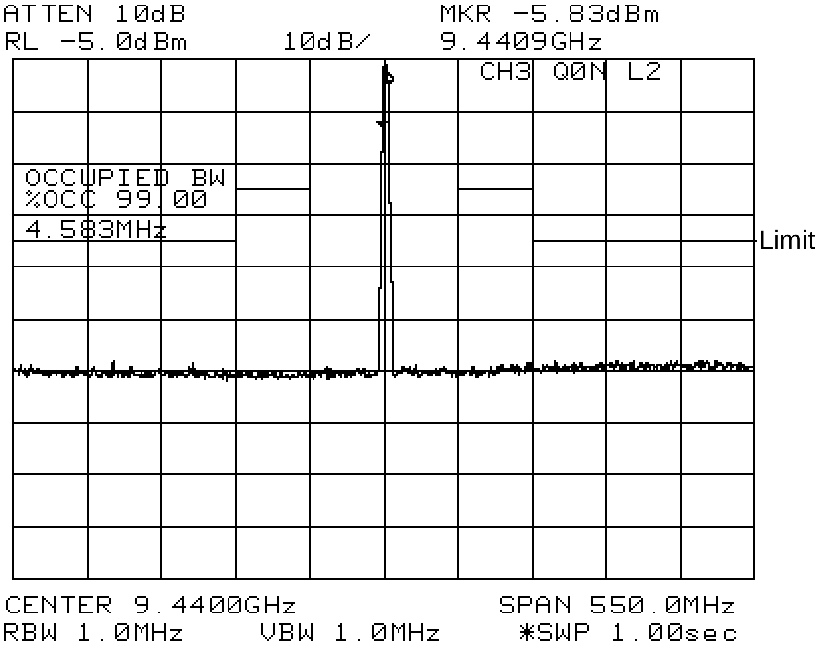


Fig. 7.54 ch3, Q0N, L2 pulse

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