EMPOWER RF SYSTEMS, INC.

# ACCEPTANCE TEST DATA

| Date | Job Number | SKU No. | Frequency | Output Power |
|---|---|---|---|---|
| June 26, 2023 | 17765 | 2240-001 | 5200-5900 MHz | 800W Pulsed/ 200W Long Pulse |

Power Amplifier Final Test

**ELECTRICAL SPECIFICATIONS** @ $220V_{AC}$, 25°C ambient, 50Ω System

| Parameter | Specifications | | | | | | Frequency (MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Symbol | Min | Typ | Max | Unit | Notes | 5200 | 5300 | 5400 | 5500 | 5600 | 5700 | 5800 | 5900 | | | | P/F |
| Operating Frequency - BW | BW A | 5200 | | 5900 | MHz | | | | x | x | x | x | x | x | | | | P |
| Min. $P_{in}$ for $P_{OUT}$ = 800Wpk (500µS PW, DC = 20%, MGC and Gated Input) | Pin | | -4 | | dBm | Record | | | -4.4 | -4.8 | -7.3 | -9.1 | -8.5 | -6.7 | | | | P |
| Min. $P_{in}$ for $P_{OUT}$ = 800Wpk (200nS PW, DC = 4%, MGC and Gated Input) | | | | | | | | | -9.0 | -8.8 | -10.9 | -12.3 | -11.9 | -10.1 | | | | P |
| Droop @ 800Wpk, 500µS PW, DC = 20% (MGC and Gated Input) | $P_{Droop}$ | | 1.2 | | dB | Record | | | 0.87 | 0.74 | 0.71 | 1.00 | 1.10 | 0.90 | | | | P |
| Droop @ 800Wpk, 200nS PW, DC = 4% (MGC and Gated Input) | | | | | | | | | 0.52 | 0.53 | 0.43 | 0.51 | 0.51 | 0.71 | | | | P |
| Pulse Characteristics, $P_{OUT}$ = 800Wpk (500µS PW, DC = 20%, MGC and Gated Input) | $T_{RISE}$ | | | 20 | nSec | Plots 4-7 | | | x | x | x | x | x | x | | | | P |
| | $T_{FALL}$ | | | 20 | | | | | x | x | x | x | x | x | | | | P |
| Pulse Characteristics, $P_{OUT}$ = 800Wpk (200nS PW, DC = 4%, MGC and Gated Input) | $T_{RISE}$ | | | 20 | | Plots 8-11 | | | x | x | x | x | x | x | | | | P |
| | $T_{FALL}$ | | | 20 | | | | | x | x | x | x | x | x | | | | P |
| Min. $P_{in}$ for $P_{OUT}$ = 200Wpk (2.1mS PW, DC = 20%, MGC and Gated Input) | Pin | | -15 | | dBm | Record | | | -13.3 | -13.9 | -16.2 | -17.2 | -16.3 | -14.8 | | | | P |
| Droop @ 200Wpk, 2.1mS PW, DC = 20% (MGC and Gated Input) | $P_{Droop}$ | | | 1 | dB | Record | | | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | | | | P |
| Pulse Characteristics, $P_{OUT}$ = 200Wpk (2.1mS PW, DC = 20%, MGC and Gated Input) | $T_{RISE}$ | | | 70 | nSec | Plots 12-15 | | | x | x | x | x | x | x | | | | P |
| | $T_{FALL}$ | | | 70 | | | | | x | x | x | x | x | x | | | | P |
| Harmonics @ POUT_PULSE = 800WPK | 2nd | | -25 | | dBc | Record | | | <-60 | <-60 | -48 | -48 | -45 | -44 | | | | P |
| | 3rd | | -30 | | | | | | <-60 | <-60 | <-60 | <-60 | <-60 | <-60 | | | | P |
| Input Return Loss | S11 | | | -10 | dB | Plot 1 | | | √ | √ | √ | √ | √ | √ | | | | P |
| Small Gain Flatness | ΔG | | | ±3.5 | dB | Plot 1 | | | √ | √ | √ | √ | √ | √ | | | | P |
| Gain @ Shutdown Condition, $P_{IN}$ = 0dBm | $G_{SD}$ | | | -35 | dB | Plot 3 | | | √ | √ | √ | √ | √ | √ | | | | P |
| Gain Adjustment Range (500µS Pulse Width MGC mode and gated input) | VVA | 20 | | | dB | Plot 2 | | | √ | √ | √ | √ | √ | √ | | | | P |
| Spurious Signals | Spur | | | -60 | dBc | Record | | | <-60 | <-60 | <-60 | <-60 | <-60 | <-60 | | | | P |
| Noise Power density | $N_{SD}$ | | | -100 | dBm/1MHz | Record | <-105 | | | | | | | | | | | P |

**ELECTRICAL SPECIFICATIONS (cont.)** @ $220V_{AC}$, 25°C ambient, 50Ω System

| Parameter | Specifications | | | | | | Frequency (MHz) | | | | | | | | | | | P/F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Symbol | Min | Typ | Max | Unit | Notes | 5200 | 5300 | 5400 | 5500 | 5600 | 5700 | 5800 | 5900 | | | | |
| Operating Voltage | $V_{AC}$ | 200 | 208 | 220 | V | Record | | | 205 | 205 | 205 | 205 | 205 | 205 | | | | P |
| Current Consumption (ΦC) (100µS PW, DC=6%, MGC and Gated Input) | IDC | | | | A | Record | | | | | | | | | | | | |
| Power Consumption @ $P_{OUT}$ = 800Wpk (500µS PW, DC=20%, MGC and Gated Input) | $P_D$ | | | 1.5 | kVA | Record | | | 1.07 | 0.94 | 1.00 | 0.86 | 0.86 | 0.86 | | | | P |
| Power Consumption @ $P_{OUT}$ = 200Wpk (2.1mS PW, DC=20%, MGC and Gated Input) | $P_D$ | | | 1 | kVA | Record | | | 0.47 | 0.45 | 0.48 | 0.55 | 0.53 | 0.55 | | | | P |
| Sample Port @ 800Wpk 500µS pulse width; 20% duty cycle, MGC = 100% (Measured at the middle of the pulse) | $P_{SAMPLE}$ | | | | dBm | Record | | | -0.55 | -0.56 | -0.30 | -0.40 | -0.50 | -0.44 | | | | P |
| Efficiency @ 800Wpk | η | | | | % | Computed | | | 9.4 | 10.6 | 10.0 | 11.6 | 11.6 | 11.6 | | | | P |
| Power Consumption @ Shutdown | $P_{SD}$ | | | | kVA | Record | 0.15 | | | | | | | | | | | P |
| Quiescent Power Consumption | $P_{DQ}$ | | | | kVA | Record | 0.19 | | | | | | | | | | | P |
| NTE Test @ limiter threshold | $P_{OOD}$ | | | 60.5 | dBm | Record $P_{OUT}$ | - | - | - | 60 | - | - | - | - | | | | P |
| Input Overdrive - Shutdown | $P_{IOD}$ | | | 10 | dBm | Verify | √ | | | | | | | | | | | P |
| VSWR - Shutdown | VSWR | | 2:01 | | - | Verify | √ | | | | | | | | | | | P |
| Thermal Overload - Shutdown | $T_{OD}$ | | | 95 | °C | Verify | √ | | | | | | | | | | | P |

**INTERFACE**

| System Controller | SW/FW | NTE | Max MGC | Set Point | | Fwd./Rev. | Watt/dB | USB | RS232/RS422 | Monitors |
|---|---|---|---|---|---|---|---|---|---|---|
| | Version | dBm | Percent | Min | Max | - | - | - | - | - |
| Verify / Record | 01.29.25 | 60 | 100 | 0 | 100 | √ | √ | - | √ | - |

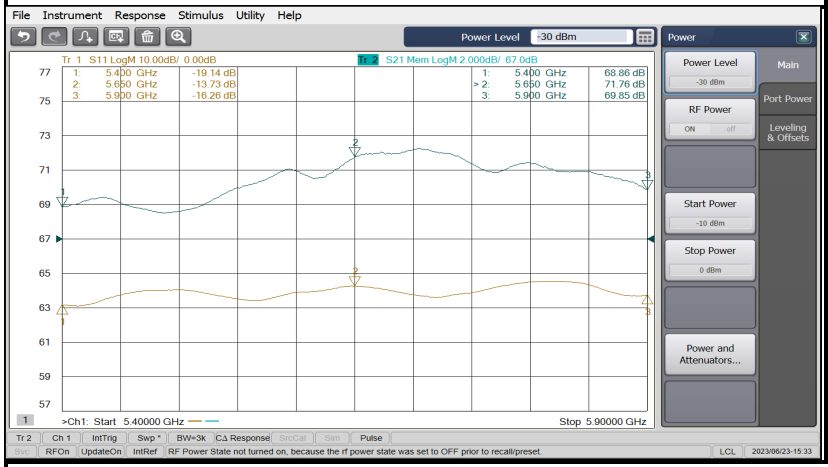
**Plot 1 - Small Signal Gain and Input Return Loss (Peak)**

Top Curve: Small Signal Gain @ $P_{IN}$ = -30dBm

Reference:67dB, 2dB/div.

Bottom Curve: Input Return Loss

Reference: 0dB, 10dB/div.



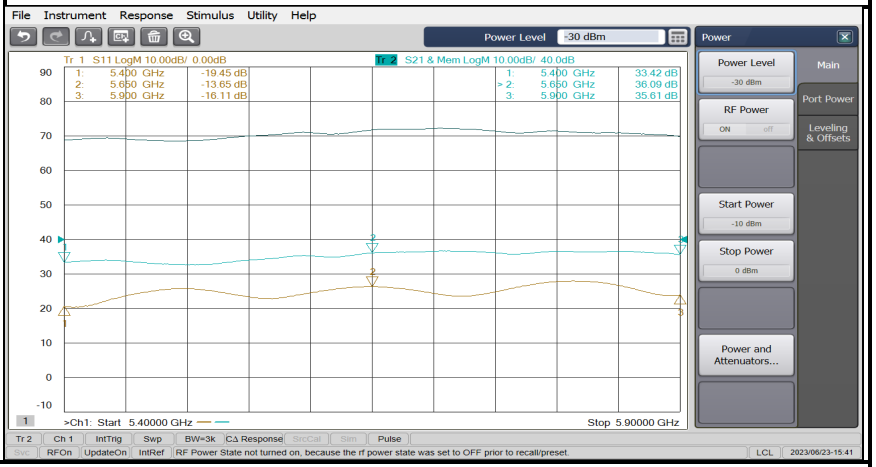

**Plot 2 -Gain adjustment range**

Top Curve (Trace Memory): Maximum Gain (MGC Mode and $P_{IN}$ = -30dBm)

Reference :40dB, 10dB/div.

Bottom Curve (Active Trace): Minimum Gain (MGC Mode and $P_{IN}$ = -30dBm)

Reference: 40dB, 10dB/div.



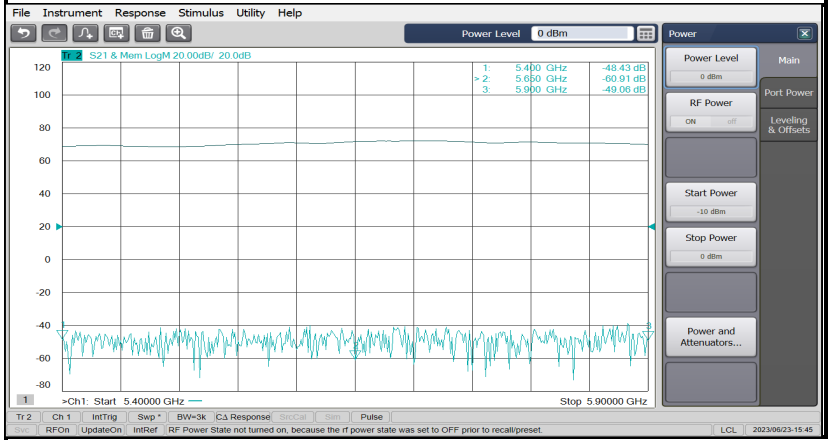

**Plot 3 - Gain at shutdown condition**

Top Curve (Trace Memory): Maximum Gain (MGC Mode and $P_{IN}$ = -30dBm)

Reference:20dB, 20dB/div.

Bottom Curve: (Active Trace): Gain at Shutdown (MGC Mode and $P_{IN}$ = 0dBm)

Reference: 20dB, 20dB/div.

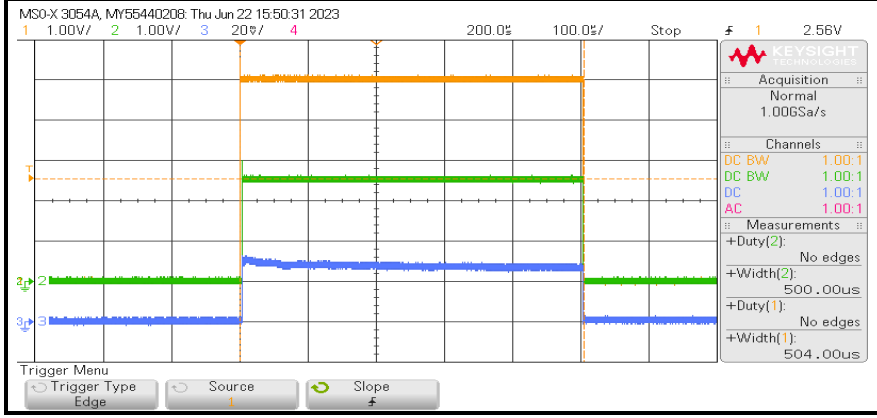


**Performance Plots**

**Plot 4 - Pulse Performance - 500µs PW and DC=20%**

Pulse at 59dBm Peak Average

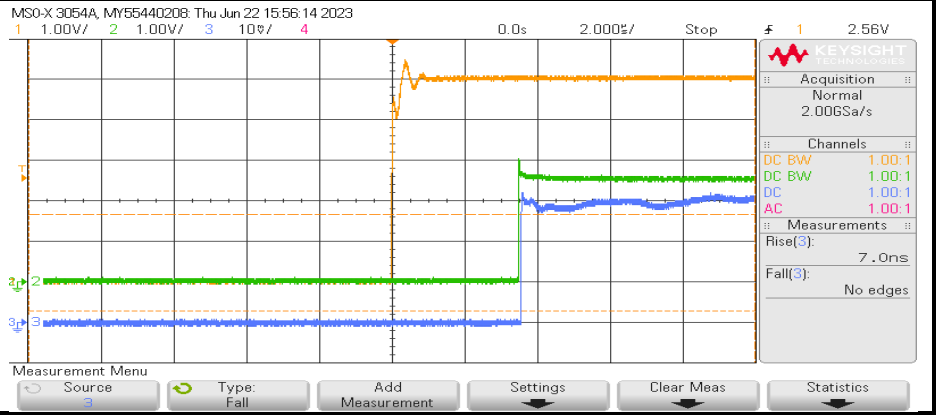
Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger




**Plot 5 - Pulse Performance - Typical Rise time- 500µs PW and DC=20%**

Pulse at 59dBm Peak Average, Guard Interval = 3.5us

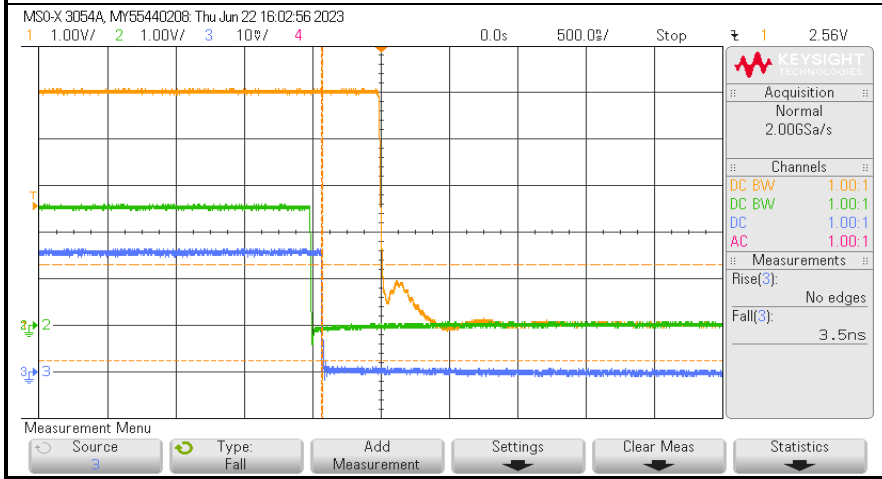
Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger



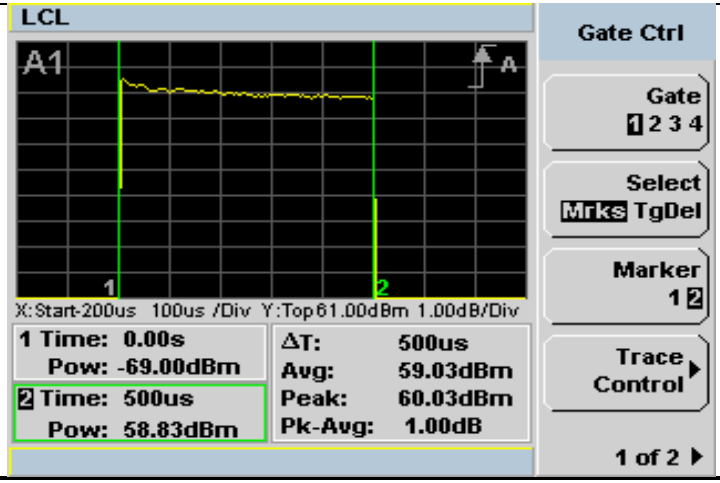

**Plot 6 - Pulse Performance - Typical Fall time- 500µs PW and DC=20%**

Pulse at 59dBm Peak Average

Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger




**Plot 7 - Pulse Performance - 500µs PW and DC=20%**



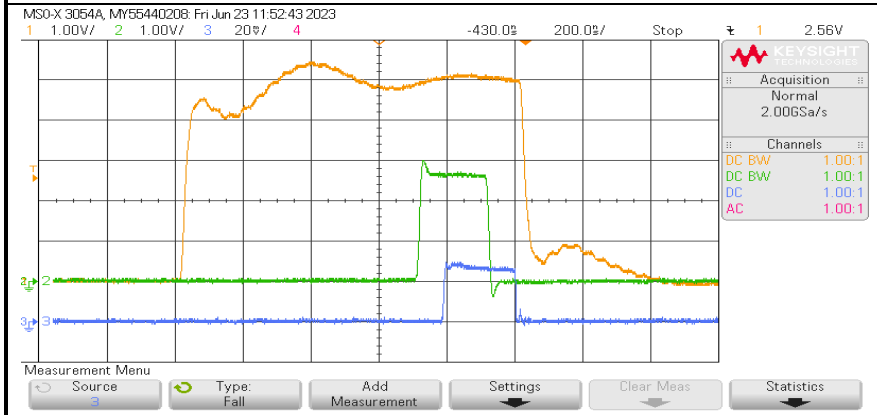
| Date | Job Number | Serial No. | Part Number | Model | Rev. | Frequency | Output Power | Gain | Customer | PO |
|---|---|---|---|---|---|---|---|---|---|---|
| June 26, 2023 | 17765 | #REF! | #VALUE! | #REF! | #REF! | #VALUE! | #VALUE! | #REF! | #REF! | #REF! |

**Performance Plots**

**Plot 8 - Pulse Performance - 200ns PW and DC=4%**

Pulse at 59dBm Peak Average

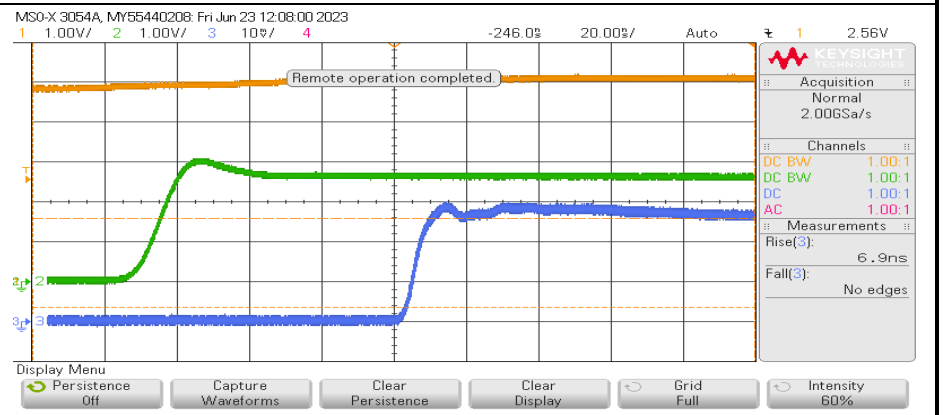
Yellow Trace = Blanking signal (20% duty-cycle), Blue trace = RF Envelope, Green trace = sig gen trigger




**Plot 9 - Pulse Performance - Typical Rise time- 200ns PW and DC=4%**

Pulse at 59dBm Peak Average, Guard Interval = 700ns

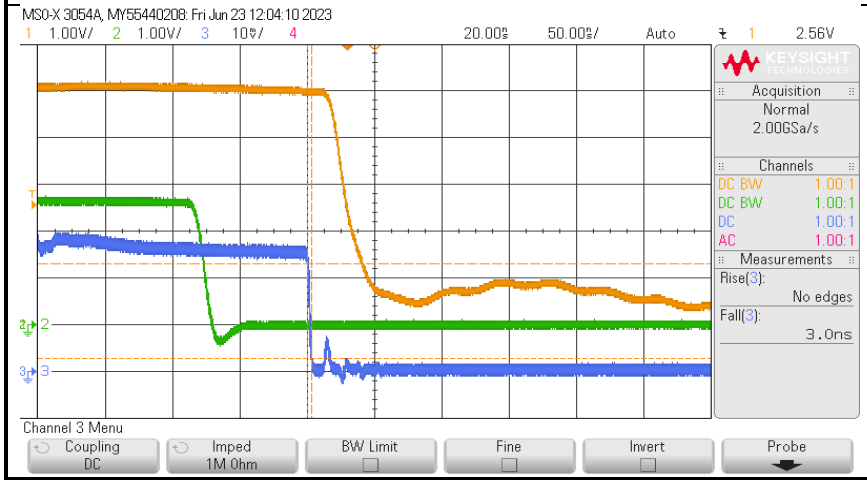
Yellow Trace = Blanking signal (20% duty-cycle), Blue trace = RF Envelope, Green trace = sig gen trigger



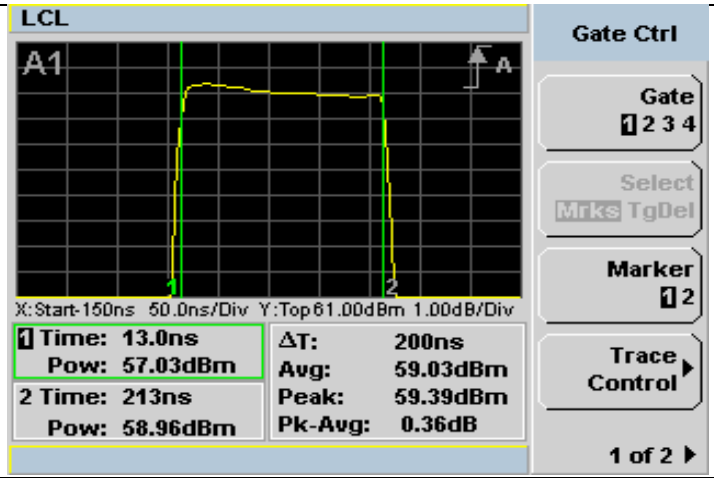

**Plot 10 - Pulse Performance - Typical Fall time- 200ns PW and DC=4%**

Pulse at 59dBm Peak Average

Yellow Trace = Blanking signal (20% duty-cycle), Blue trace = RF Envelope, Green trace = sig gen trigger



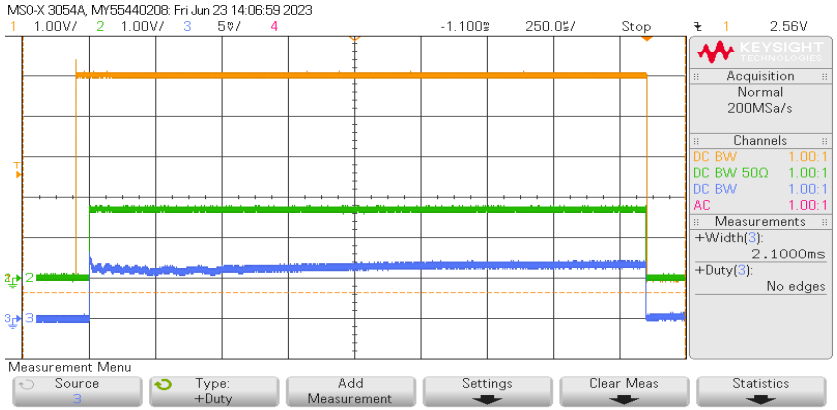

**Plot 11 - Pulse Performance - 200ns PW and DC=4%**



**Plot 12 - Pulse Performance - 2.1ms PW and DC=20%**

Pulse at 53dBm Peak Average

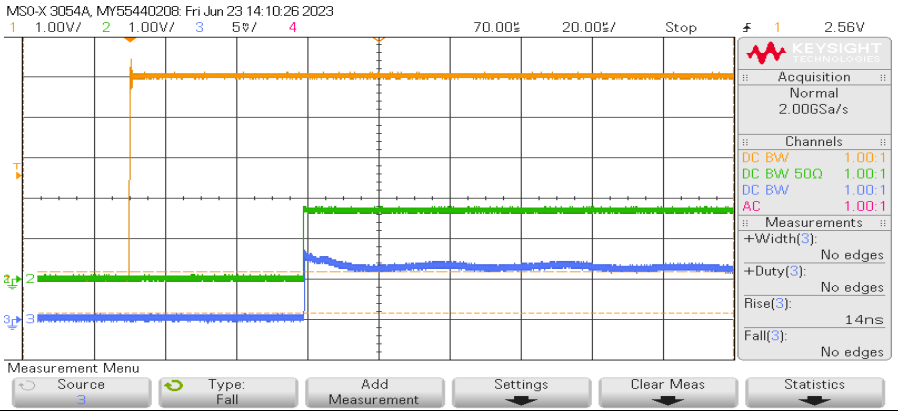
Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger




**Plot 13 - Pulse Performance - Typical Rise time- 2.1ms PW and DC=20**

Pulse at 53dBm Peak Average, Guard Interval = 50µs

Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger

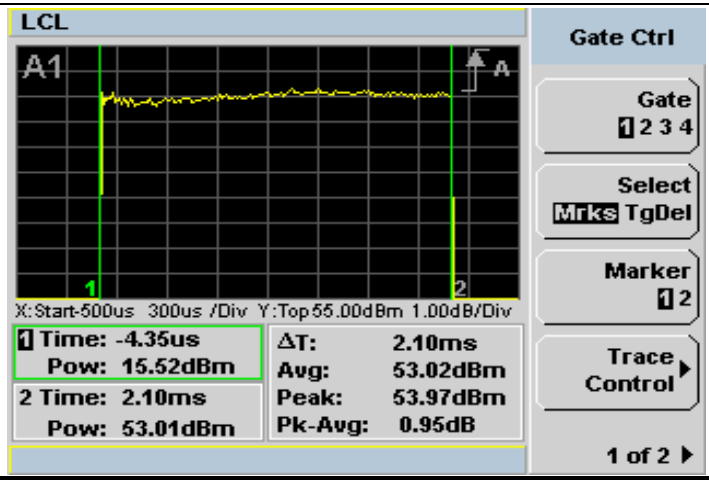



**Plot 14 - Pulse Performance - Typical Fall time- 2.1ms PW and DC=20%**

Pulse at 53dBm Peak Average

Yellow Trace = Blanking signal, Blue trace = RF Envelope, Green trace = sig gen trigger


**Plot 15 - Pulse Performance - 2.1ms PW and DC=20%**



Power Reporting Accuracy

| Forward Power, 50 Ohm Load (Pulse/Long Pulse) | | | | | | |
|---|---|---|---|---|---|---|
| Frequency (GHz) | Measurement Method | 500uS pulse width, 20% DC @ | 200nS pulse width, 4% DC @ | 2.1mS pulse width, 20% DC @ | Limits | P/F |
| 5.4 | External Test Equipment | 59 | 59 | 53 | ±1 dB | P |
| | Ethernet Reporting | 58.6 | 59.5 | 52.2 | | |
| 5.6 | External Test Equipment | 59 | 59 | 53 | ±1dB | P |
| | Ethernet Reporting | 58.5 | 59.4 | 52.2 | | |
| 5.8 | External Test Equipment | 59 | 59 | 53 | ±1 dB | P |
| | Ethernet Reporting | 58.6 | 59.5 | 52 | | |