

ScanWave PCBs

Part Number:	700004167 (Storage PCB) 700004168 (ScanWave PCB) 700004174 (Barrier PCB)	Where Used:	Xevo TQ MS / Xevo TQ-S / Xevo TQ-XS
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Functional description

- Three types of ScanWave boards (storage PCB, ScanWave PCB, and barrier PCB) provide RF and/or DC to the ScanWave collision cell assembly.
- The storage and ScanWave PCBs provide a combination of pulse, bias, and RF voltages to the T-Wave element pairs in the storage, ScanWave, cooling, and DC barrier sections of the collision cell.
- The RF barrier PCB provides RF to the RF barrier section of the T-Wave cell.

WARNING: Suitable precautions must be taken when working on the PCBs as RF and high voltages are produced.

NOTE: See Service Notes for the latest firmware for the ScanWave PCBs.

Differences in the ferrite cores and winding PCBs on each type of ScanWave boards (storage PCB, ScanWave PCB, barrier PCB) means that the ScanWave boards types are not interchangeable.

Location

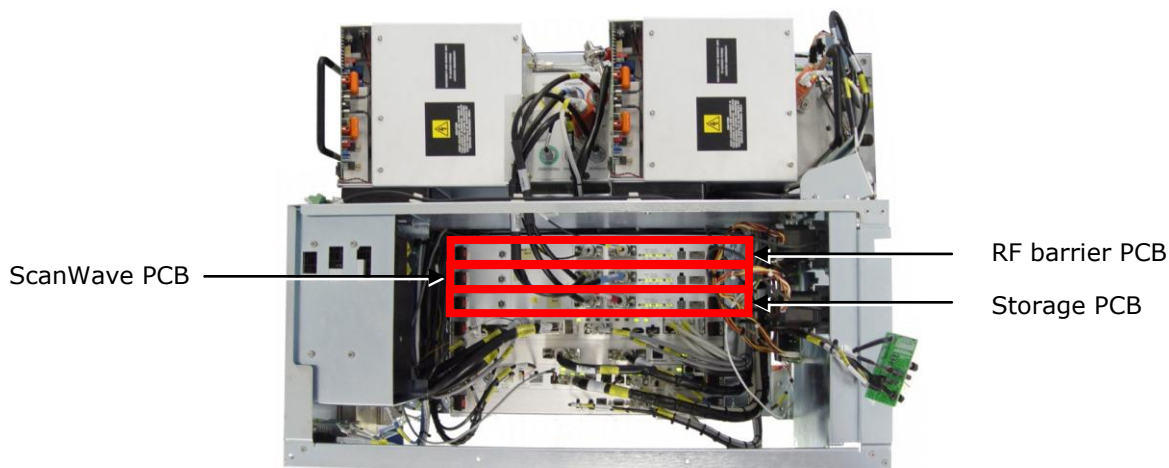
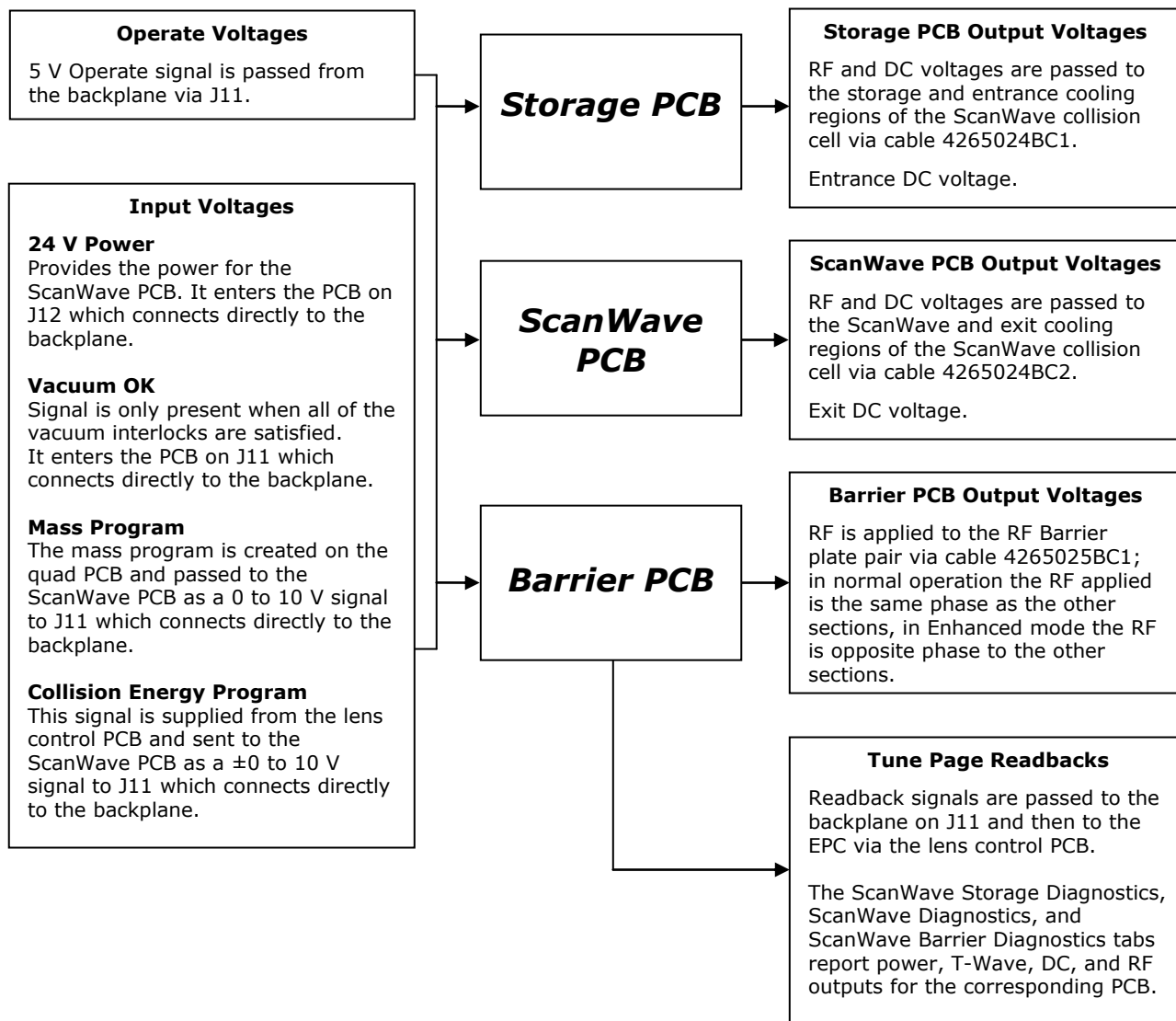


Figure 1 - Top internal view of the Xevo TQ MS

Inputs/outputs

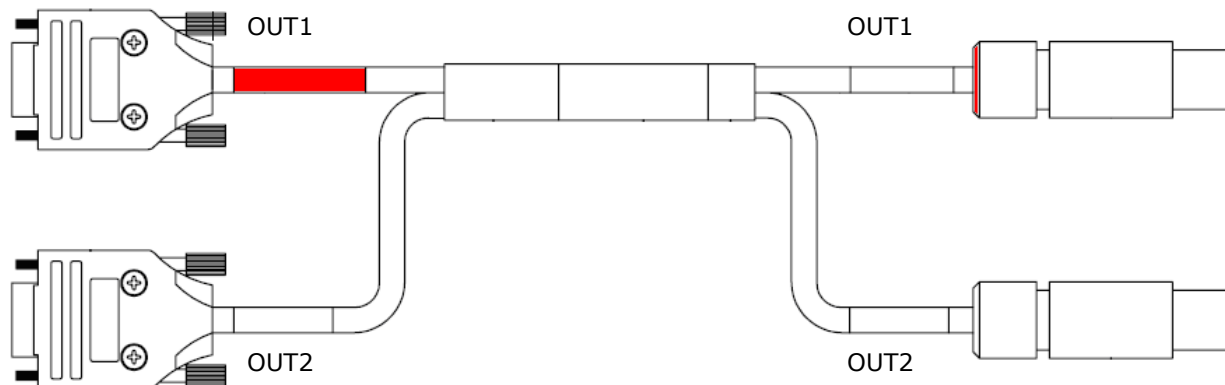


NOTE:

Two cables run between each ScanWave PCB and the analyzer lid. These cables are color-coded and labeled OUT1 (colored end) and OUT2 (non-colored). The colored OUT1 cables are always attached at the source side of each PCB and to the colored ports on the analyzer lid. Failure to attach the correct cable to the correct port will result in the wrong phase of RF being applied to a section of the collision cell, and severely reduced signal intensity in Gas On mode.

Storage output cable 4265024BC1 to the analyzer lid

The output signals from the storage PCB are for the storage section, entrance plate, and entrance cooling section of the collision cell assembly.

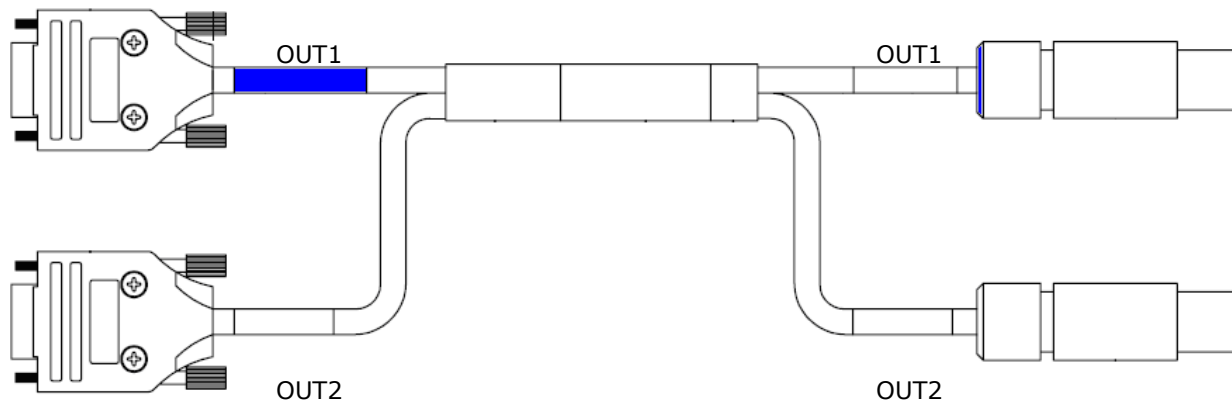


External Connections		Internal Connections		Function
15 W D-Type Pin No.	Fischer Pin No.	P2 6 W Harwin Pin No.	P3 6 W Harwin Pin No.	
9	1	1		OUT1 (Storage)
2	2	4		OUT2 (Storage)
10	3	6		OUT3 (Storage)
3	4	3		OUT4 (Storage)
11	5	5		OUT5 (Storage)
4	6		2	OUT6 (Cooling)
12	7		4	OUT7 (Cooling)
5	8		3	OUT8 (Cooling)
13	9		5	OUT9 (Cooling)
6	10		6	OUT10 (DC Barrier)
8	11			Entrance (on OUT1 cable only)

NOTE: For further information regarding the internal connections see the ScanWave Collision Cell Assembly Technical Reference Sheet.

ScanWave output cable 4265024BC2

The output signals from the ScanWave PCB are for the ScanWave section, exit plate, and exit cooling section of the collision cell assembly.



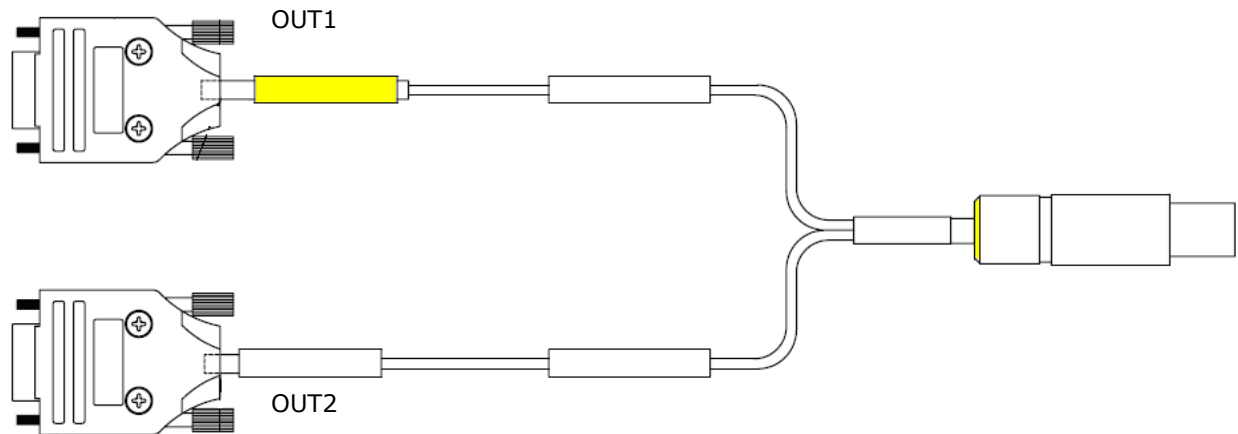
External Connections		Internal Connections		Function
15 W D-Type Pin No.	Fischer Pin No.	P2 6 W Harwin Pin No.	P3 6 W Harwin Pin No.	
9	1	6		OUT1 (ScanWave)
2	2	1		OUT2 (ScanWave)
10	3	3		OUT3 (ScanWave)
3	4	2		OUT4 (ScanWave)
11	5	4		OUT5 (ScanWave)
4	6		4	OUT6 (cooling)
12	7		1	OUT7 (cooling)
5	8		3	OUT8 (cooling)
13	9		5	OUT9 (cooling)
6	10		2	OUT10 (ScanWave)
8	11			Exit (on OUT1 cable only)

NOTE:

For further information regarding the internal connections, refer to the [Xevo TQ MS ScanWave Collision Cell Assembly Technical Reference Sheet](#) (p/n 715002670), or the [Xevo TQ-S / Xevo TQ-XS ScanWave Collision Cell Assembly Technical Reference Sheet](#) (p/n 715002816).

Barrier output cable 4265025BC1 (RF barrier PCB)

The output signals from the barrier PCB are for the RF barrier.



External Connections			Internal Connections		Function
P1 15 W D-Type Pin No.	P2 15 W D-Type Pin No.	P3 Fischer Pin No.	P2 6 W Harwin Pin No.	P3 6 W Harwin Pin No.	
13	-	1	5	-	Barrier OUT1 (RF Barrier)
-	13	2	-	5	Barrier OUT2 (RF Barrier)

NOTE: For further information regarding the internal connections, refer to the [Xevo TQ MS ScanWave Collision Cell Assembly Technical Reference Sheet](#) (p/n 715002670), or the [Xevo TQ-S / Xevo TQ-XS ScanWave Collision Cell Assembly Technical Reference Sheet](#) (p/n 715002816).

Diagnostic procedures

1. Click **View > System Diagnostics** on the Tune page.
2. Type **1147** as the password and press **Enter**.
3. Click the **ScanWave Storage Diagnostics** tab to view storage diagnostics, the **ScanWave Diagnostics** tab to view ScanWave diagnostics, or the **ScanWave RF Barrier Diagnostics** tab to view RF barrier diagnostics.

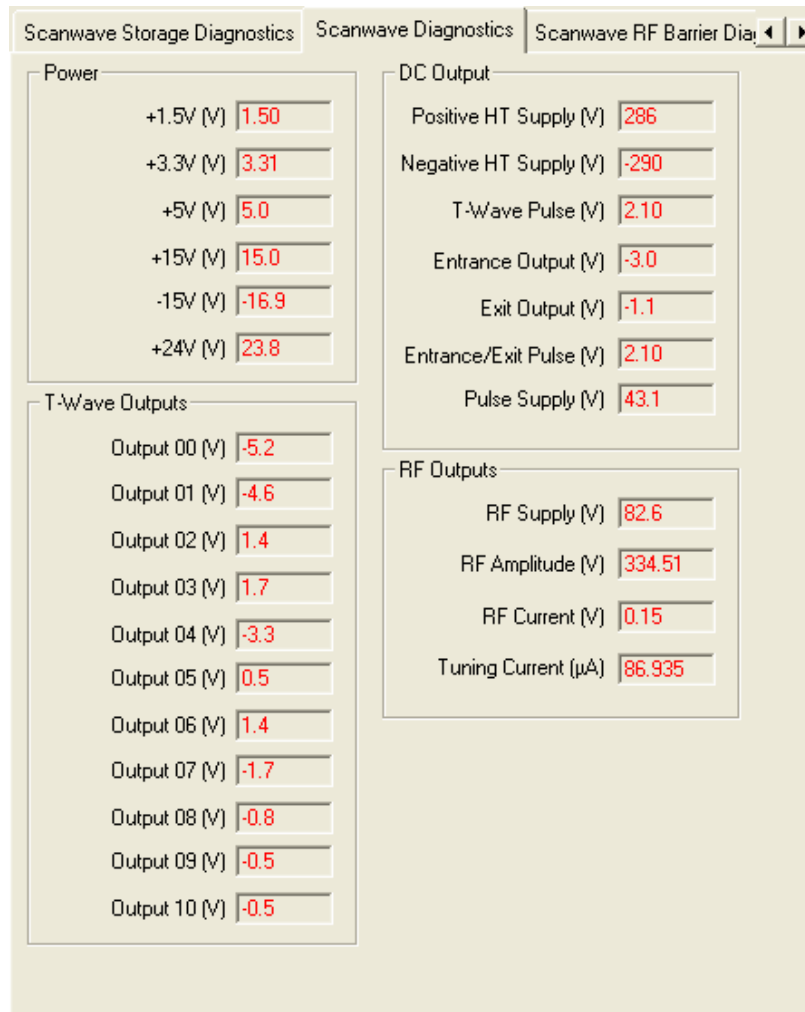


Figure 2 - The ScanWave Diagnostics tab

Power (V) readbacks

The 24 V is an externally created voltage. It is generated on the power module PCB and sent to the ScanWave, storage, and RF barrier PCBs via the turbo-midplane PCB and backplane PCB.

The 24 V is used to supply the following:

- Electronics LV supply
- RF and HT circuits
- Continuous 24 V power outlet
- Switched 24 V power outlet

A resettable thermal fuse, located close to the incoming supply at the backplane connector, is used on each of these circuits.

The 24 V input is also used to produce a number of HV supplies:

- 82 V for the RF amplifier supply
- 42 V for the pulse voltage supply
- ± 250 V for the pulse amplifier HT rails

See the DC Output section of the Diagnostics tab.

All other voltages displayed in the Power (V) section are created on the PCB itself. A dual output DC-DC converter produces the ± 15 V supply rails. A second DC-DC converter provides the 3.3 V supply for the digital circuitry. A linear regulator creates 1.5 V from the 3.3 V.

T-Wave outputs (V) readbacks

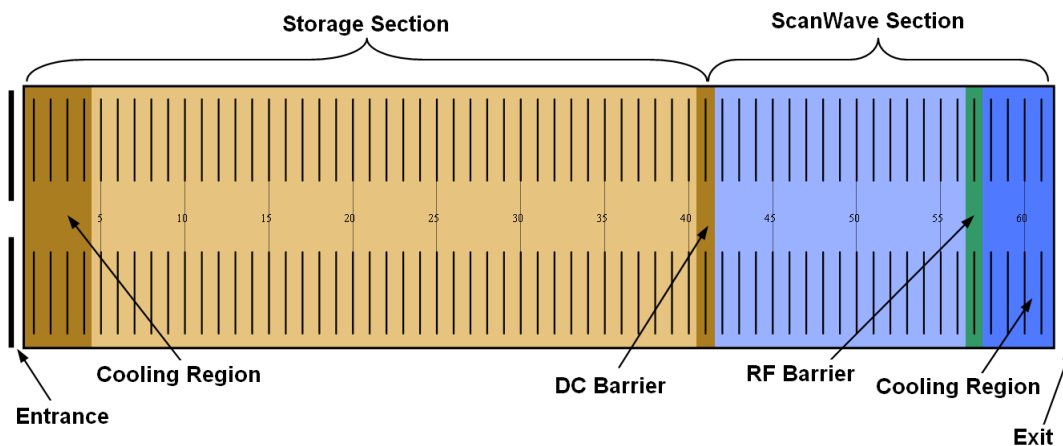


Figure 3 - ScanWave collision cell

ScanWave Storage Diagnostic tab

The ScanWave storage PCB provides voltages for the storage (collision) section of the ScanWave collision cell. All plates in this section have the same RF amplitude applied to them. A traveling wave (with a repeat pattern of five) is applied to plate pairs along the majority of this section (OUT1 to OUT5).

The cooling region plates at the entrance (OUT6 to OUT9) only have the traveling wave pulse turned on during the Interscan.

The DC barrier plate (OUT10) pulses as part of the traveling wave when in normal scan mode. However, when the cell is operated in ScanWave mode a DC potential is applied to this plate, preventing the passage of ions between the two sections.

ScanWave Diagnostics tab

The ScanWave PCB provides voltages for the ScanWave section of the ScanWave collision cell. A traveling wave (with a repeat pattern of five) is applied to the plate pairs along the majority of this section (OUT1 to OUT5). The cooling region plates at the exit (OUT6 to OUT9) only have the traveling wave pulse turned on during the Interscan.

RF barrier

The RF barrier is a pair of plates located between the ScanWave and ScanWave cooling sections in the collision cell.

In normal mode the voltage on the RF barrier plates is in-phase with the RF in the ScanWave section, i.e. opposite RF phase relative to their adjacent plates.

In ScanWave mode(s) the RF on the two RF barrier plates is 180° out of phase with the other RF in the ScanWave section. The RF applied to the RF barrier is ramped nonlinearly during ScanWave mode; the ramp is determined by the ScanWave optimization. During the Interscan time the RF barrier has a DC offset applied to prevent high energy ions passing straight over the RF barrier when the DC barrier is dropped. A DC bias voltage is also possible on this plate pair, see below.

DC offsets applied to T-Wave outputs

Three DC offset voltages are applied to different sections of the collision cell. The DC reference voltages correspond to the Tune page parameters in [Figure 4](#).

- The ScanWave DC offset is applied to the storage section of the collision cell only
- The barrier DC offset is applied only to the RF barrier plates
- The cooling DC offset is applied to the whole collision cell

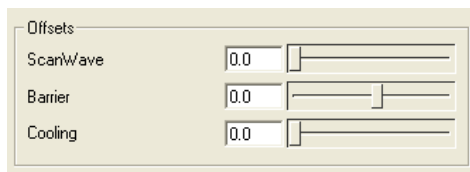


Figure 4 - DC offsets on the Storage tab

DC output readbacks

Positive/negative HT supply (V)

These give the current status of the pulse amp high voltage supply. If no voltage is shown in Operate (and all the other settings/parameters are satisfactory and there are no other instrument faults) then the related PCB for that section may have failed and need replacing.

T-Wave pulse (V)

As described in the "[T-Wave outputs \(V\) readbacks](#)" section, each of the three ScanWave sections may have a T-Wave pulse applied to the plates. This voltage readback describes the magnitude of this pulse.

Entrance and exit outputs (V)

The entrance output is provided by the storage PCB and the exit output is provided by the ScanWave PCB. The voltages depend upon the Tune page settings that have been optimized for each mode.

Pulse supply (V)

This is a separate supply used for the T-Wave pulses on each of the three sections. Since the maximum pulse amplitude is 30 V, the pulse amplifier requires at least this voltage to supply the output, which is controlled by an opamp.

RF outputs readbacks

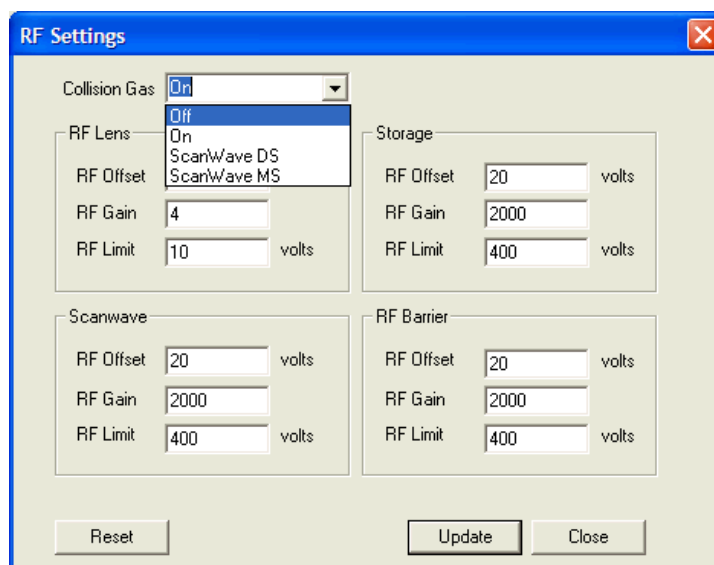
RF supply (V)

This is an 82 V power supply that is generated internally on each of the three boards.

RF amplitude (V)

This value is mass dependent. The displayed value is set by the settings in [Figure 5](#) to [Figure 8](#).

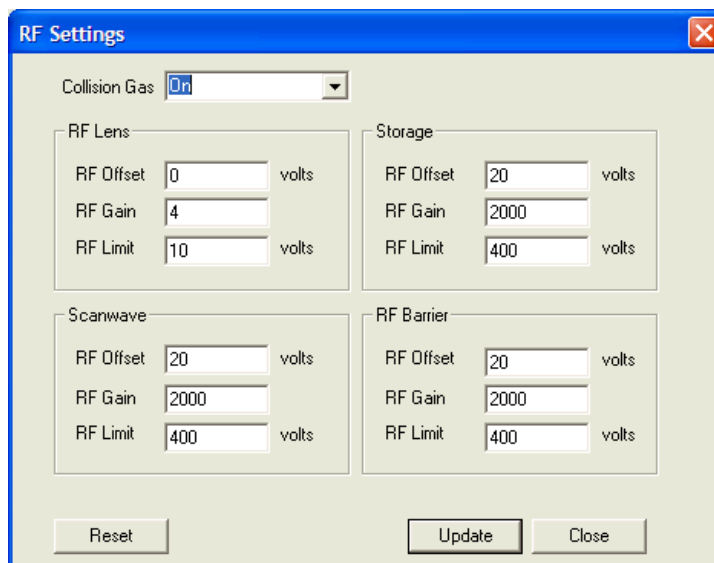
NOTE: *These setting must not be adjusted as they may affect the performance of the instrument. They must only be used as a reference.*



The RF Settings window displays various parameters for the RF system. The Collision Gas is set to On. The RF Lens is set to Off, with a dropdown menu showing ScanWave DS and ScanWave MS. The RF Offset is 20 volts, RF Gain is 4, and RF Limit is 10 volts. The Storage section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. The Scanwave section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. The RF Barrier section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. Buttons for Reset, Update, and Close are at the bottom.

Parameter	Value	Unit
Collision Gas	On	
RF Lens	Off	
RF Offset	20	volts
RF Gain	4	
RF Limit	10	volts
Storage RF Offset	20	volts
Storage RF Gain	2000	
Storage RF Limit	400	volts
Scanwave RF Offset	20	volts
Scanwave RF Gain	2000	
Scanwave RF Limit	400	volts
RF Barrier RF Offset	20	volts
RF Barrier RF Gain	2000	
RF Barrier RF Limit	400	volts

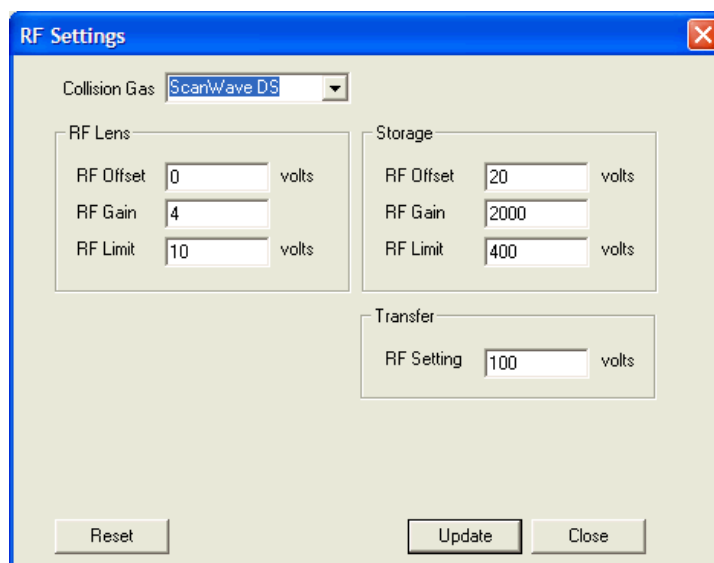
Figure 5 - RF Settings window (Normal mode - gas off)



The RF Settings window displays various parameters for the RF system. The Collision Gas is set to On. The RF Lens is set to On, with a dropdown menu showing ScanWave DS and ScanWave MS. The RF Offset is 0 volts, RF Gain is 4, and RF Limit is 10 volts. The Storage section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. The Scanwave section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. The RF Barrier section shows RF Offset 20 volts, RF Gain 2000, and RF Limit 400 volts. Buttons for Reset, Update, and Close are at the bottom.

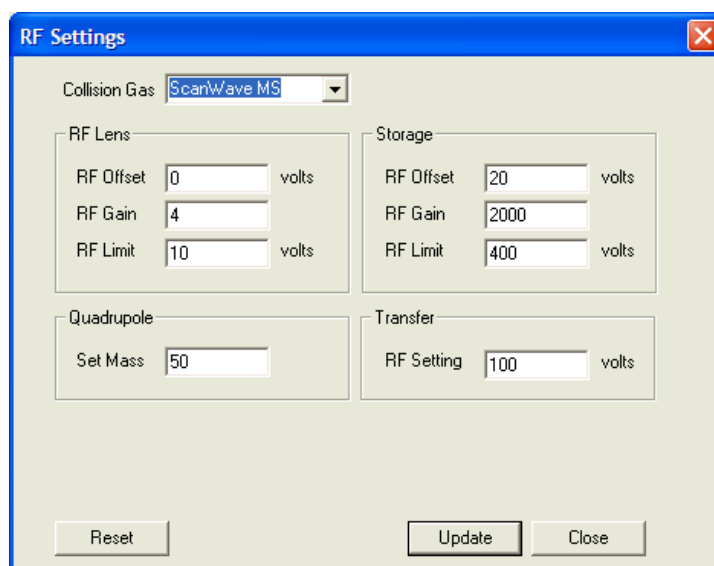
Parameter	Value	Unit
Collision Gas	On	
RF Lens	On	
RF Offset	0	volts
RF Gain	4	
RF Limit	10	volts
Storage RF Offset	20	volts
Storage RF Gain	2000	
Storage RF Limit	400	volts
Scanwave RF Offset	20	volts
Scanwave RF Gain	2000	
Scanwave RF Limit	400	volts
RF Barrier RF Offset	20	volts
RF Barrier RF Gain	2000	
RF Barrier RF Limit	400	volts

Figure 6 - RF Settings window (Normal mode - gas on)



The RF Settings window for a ScanWave DS scan. It features a 'Collision Gas' dropdown menu set to 'ScanWave DS'. Below this are three input fields: 'RF Offset' (0 volts), 'RF Gain' (4), and 'RF Limit' (10 volts). To the right, under the 'Storage' section, are three input fields: 'RF Offset' (20 volts), 'RF Gain' (2000), and 'RF Limit' (400 volts). Below these is a 'Transfer' section with an 'RF Setting' input field set to 100 volts. At the bottom are three buttons: 'Reset', 'Update', and 'Close'.

Figure 7 - RF Settings window (ScanWave daughter scan)



The RF Settings window for a ScanWave MS scan. It features a 'Collision Gas' dropdown menu set to 'ScanWave MS'. Below this are three input fields: 'RF Offset' (0 volts), 'RF Gain' (4), and 'RF Limit' (10 volts). To the right, under the 'Storage' section, are three input fields: 'RF Offset' (20 volts), 'RF Gain' (2000), and 'RF Limit' (400 volts). Below these is a 'Quadrupole' section with a 'Set Mass' input field set to 50. To the right of the Quadrupole section is a 'Transfer' section with an 'RF Setting' input field set to 100 volts. At the bottom are three buttons: 'Reset', 'Update', and 'Close'.

Figure 8 - RF Settings window (ScanWave MS scan)

Create an RF amplitude scan, see [Figure 9](#), by selecting the RF settings for the following modes:

- Gas off – MS
- Gas on – MS
- Gas on – MSMS

The RF starts at a peak-to-peak voltage of 20 V at 2 Da. The RF then follows a linear gradient (defined by the RF gain value in the RF Settings window) up to a peak-to-peak voltage of 400 V (defined by the RF limit in the RF Settings window) at 390 Da. The RF stabilizes at this value for any masses higher than 390 Da.

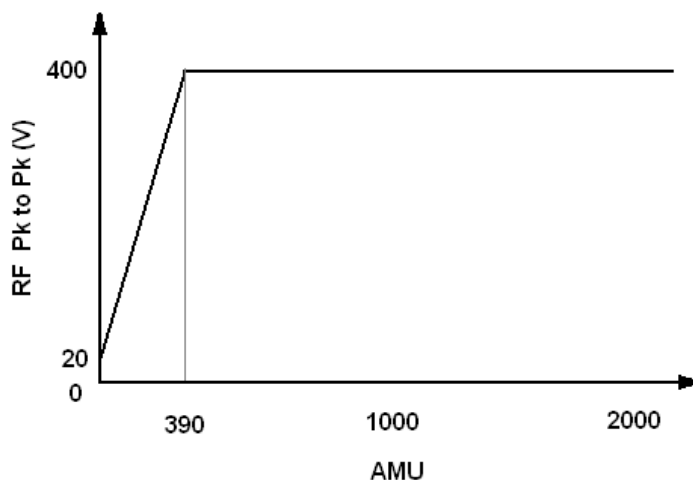


Figure 9 - RF peak-to-peak voltages for MS and MSMS

In ScanWave mode the ScanWave and barrier RF amplitude follow a complex function which is calculated within the board itself.

RF current (A)

This is the current drawn by the RF supply and is limited to 0.85 A at maximum RF amplitude.

Tuning current (μ A)

This value represents the current required to maintain the RF tuning of the three ScanWave PCBs.

Table 1: Tuning current problems

Value	Problem
0 mA	Results from a lack of load (open circuit): loose wiring or poor solder joints in the cables from the ScanWave PCB to the ScanWave collision cell.
198 mA	Results from a short/partial short in the ScanWave cables, ScanWave collision cell, or a faulty PCB.

NOTE: See the *ScanWave Collision Cell Assembly Technical Reference Sheet* for details on how to determine the cause of a 0 or 198 mA tuning current.

Measuring the DC offsets on the ScanWave PCBs

The DC offsets on each section of the collision cell can be measured with a DVM after the RF on the cell has been turned off.

1. On the host PC click **Start > Run**, enter **telnet epc**, and click **OK**.
2. Type **rioMainMenu** in the Telnet window.

NOTE: *The commands in Telnet are case sensitive and there are no spaces in the entries. Default settings will also be restored by rebooting the EPC.*

3. Enter the following numerical commands to turn off the RF on each PCB:

Table 2: Numerical commands

RioMainMenu Action	Storage PCB	ScanWave PCB	Barrier PCB
Access sub-systems	3	3	3
Selects the relevant PCB	5	6	7
Drive properties	1	1	1
Disables RF on the relevant PCB (Xevo TQ MS)	989	1220	1489
Disables RF on the relevant PCB (Xevo TQ-S / Xevo TQ-XS)	1061	1264	1458
Exit	999	999	999
Exit	999	999	999

WARNING: *Check the RF amplitude readback on the Storage, ScanWave, and Barrier Diagnostics windows before disconnecting the D-types. If the readback displays <2 then the RF is disabled.*

4. With the instrument in Standby disconnect the OUT1 cables from the ScanWave PCBs.
5. Set MS1 (gas off) mode (no T-Wave is applied).
6. Place one DVM lead on a connector pin position and the other end to the chassis.
7. See the storage, ScanWave, and barrier tables in the "Inputs/outputs" section for pin position to corresponding outputs.
8. Place the instrument into Operate.
9. The DVM will show the set DC offset set in the software.

10. Perform the above for OUT1 and OUT2 cables on all the ScanWave PCBs.

NOTE: *With the RF off an oscilloscope can be used to observe the traveling wave DC pulse from OUT1 to OUT5 on the storage and ScanWave sections of the ScanWave collision cell. The pulse polarity is the same as the ionization mode.*



Figure 10 - DC pulse

11. After completing the DC pulse check, the RF must be enabled again using the following commands in Rio:

- 988 Enables the RF on the storage PCB
- 1219 Enables the RF on the ScanWave PCB
- 1488 Enables the RF on the RF barrier PCB

12. Switch between Standby/Operate and place into Standby again.

13. To ensure the correct TW patterns are used enter the following codes into rioMainMenu:

- 91 TWAVE_PATTERN_RESET_COMMAND
- 92 TWAVE_PATTERN_RESET_CLEAR_COMMAND

14. Reboot the EPC via Telnet.

15. Return the DC offsets to zero before leaving site.

NOTE: *Discuss the results of this test with GSS before proceeding to change a PCB. Incorrect measurement/interpretation of voltages or a corrupt target registry can appear to give false results for this test.*

Other relevant information

Removing the ScanWave PCBs

1. Close the Tune page.
2. Switch into pump override.
3. Switch off the electronics.
4. Remove the top and left-hand side instrument covers.
5. Remove the two 15 W D-type connectors.
6. Remove the HVPSU from the chassis.

Reinstalling the ScanWave PCBs

1. Slide the PCB into the slot in the electronics enclosure.
2. Ensure the PCB is flush with the other PCBs in the enclosure and close the securing clips.
3. Connect the two 15 W D-type connections.
4. Switch on the electronics, wait for the boot-up sequence to complete, then switch the pump override to Auto.

NOTE: *After replacing a PCB ensure the Tune page readbacks are correct for the relevant ScanWave tab.*

ScanWave outputs and programs

Pin (Fischer)	OUTPUT	OUTPUT	Connected to	Non-enhanced scan	Non-enhanced interscan	Enhanced	Enhanced interscan
N/C	N/C	N/C					
2	OUT 2	OUT 2	Storage section	RF + TW	RF + TW	RF + TW	RF + TW
4	OUT 4	OUT 4	Storage section	RF + TW	RF + TW	RF + TW	RF + TW
N/C	OUT 6	OUT 6	Storage section cooling	RF only	RF + TW	RF only	RF + TW
8	OUT 8	OUT 8	Storage section cooling	RF only	RF + TW	RF only	RF + TW
10	OUT 10	OUT 10	DC barrier plates	RF + TW	RF + TW	RF + DC barrier	RF + TW
N/C	N/C	N/C					
11	Entrance	Entrance	Entrance	Entrance DC voltage	Entrance DC voltage	Entrance DC voltage	Entrance DC voltage
1	OUT 10	OUT 10	Storage section	RF + TW	RF + TW	RF + TW	RF + TW
3	OUT 3	OUT 3	Storage section	RF + TW	RF + TW	RF + TW	RF + TW
5	OUT 5	OUT 5	Storage section	RF + TW	RF + TW	RF + TW	RF + TW
7	OUT 7	OUT 7	Storage section cooling	RF only	RF + TW	RF only	RF + TW
9	OUT 9	OUT 9	Storage section cooling	RF only	RF + TW	RF only	RF + TW
N/C	N/C	N/C					
N/C	N/C	N/C					
N/C	N/C	N/C					
2	OUT 2	OUT 2	ScanWave section	RF + TW	RF + TW	RF + TW	RF + TW
4	OUT 4	OUT 4	ScanWave section	RF + TW	RF + TW	RF + TW	RF + TW
N/C	OUT 6	OUT 6	ScanWave section cooling	RF only	RF + TW	RF only	RF + TW
8	OUT 8	OUT 8	ScanWave section cooling	RF only	RF + TW	RF only	RF + TW
10	OUT 10	OUT 10	ScanWave section prior to RF barrier	RF + TW	RF + TW	RF only	RF + TW
N/C	N/C	N/C					
11	Exit	Exit	Exit	Exit DC voltage	Exit DC voltage	Exit DC voltage	Exit DC voltage
1	OUT 1	OUT 1	ScanWave section	RF + TW	RF + TW	RF + TW	RF + TW
3	OUT 3	OUT 3	ScanWave section	RF + TW	RF + TW	RF + TW	RF + TW
5	OUT 5	OUT 5	ScanWave section	RF + TW	RF + TW	RF + TW	RF + TW
7	OUT 7	OUT 7	ScanWave section cooling	RF only	RF + TW	RF only	RF + TW
9	OUT 9	OUT 9	ScanWave section cooling	RF only	RF + TW	RF only	RF + TW
N/C	N/C	N/C					
N/C	N/C	N/C					
N/C	N/C	N/C					
1 and 2	OUT 9	OUT 10	RF barrier plates	RF + TW	RF + TW	RF (opposite phase to ScanWave and storage)	RF + TW
N/C	N/C	N/C					

Figure 11 - ScanWave outputs and programs