



AcqNmr: Direct Pulser-Channels Control

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Introduction

Occasionally, Stelar Users need to switch ON a particular pulser channel during a particular pulse sequence interval. The most common reasons why such a need arises are:

1. **Generating a trigger pulse** for an external device (e.g., a scope)
2. Issuing a **TTL control pulse for an external device** without defining a new X-device.
3. **Gating ON the transmitter** during an interval which is not a normal RF Pulse.

In the AcqNmr software, the goal is achieved by specifying the desired setting of the intrinsic **c**-device (pulser channels) in the desired pulse-interval parameter's options.

As a practical example, consider an FFC sequence in which one of the *Delays* is marked as *TAU*. We shall modify the default settings for that interval so as to switch ON one of the TTL pulser output channels. In particular, we will try and switch ON the **O**- and **M**-channels which are routed to the AQM coaxial connectors marked P6 and P7, respectively (see the Appendix for a complete list). According to what are your specific needs, there are four ways to do it:

I. Doing it on-the-fly

Assume that you have already loaded an FFC sequence (say PP/S) and wish to make the modification within the already loaded parameter tables. This is what you have to do:

Select the parameters page *Acq.Par|Delay*.

Press F8 to display parameter options. The interval corresponding to TAU is in this case D5 and its default options string is *m(R)*, indicating that the magnet device is set to the relaxation field.

Edit the options string to contain *m(R) c(OM)*. By adding the *c(OM)* specification, you have specified that the pulser **O**- and **M**-channels should be ON during this interval. The only precaution you must keep in mind is that the option strings are case-sensitive.

This is all! Now the sequence will execute exactly as before, but the P6 and P7 AQM outputs will go active (TTL high) every time the sequence is in the TAU-interval.

II. Saving the modified parameters for further use

Once the loaded acquisition parameters have been modified, the modifications acquire a certain degree of persistence. In particular, when you exit the program and re-enter it later on, the modifications are still present.

However, when you reload the sequence from the sequence library, any parameter modifications get lost and overwritten by library defaults. In order to make them a bit more persistence, you can Save the modified parameters in a distinctive parameters file (e.g., PP_S_P6P7TauTrigger.par). Next time you wish to use them, Load Parameters from there (in other words, parameter files keep memory of parameter options settings).

III. Modifying the library sequence

The Save/Load method is inadequate when it comes to automation procedures (such as the FFC Profile Wizard) in which sequences are automatically loaded from the sequence library. To achieve a complete persistence, you need to modify the sequence right in the library which, in this case, is the *DefaultFfcSequences.ssf* file.

Do so with NotePad or WordPad or another plain-text editor (not Word!). Open the library file and look for the following sequence definition section starting with

```
SEQUENCE PP/S
```

and terminating with

END SEQUENCE

Within this interval, find the initialization line for the D5 parameter

```
D5 :(TAU) [m(R)] 'Relaxation interval tau
```

and modified it to read

```
D5 :(TAU) [m(R) c(O)] 'Relaxation interval tau
```

Then save and close the file and the modification has become completely permanent.

IV. Creating a new library sequence

Often you wish to keep the modified sequence as well as the original, unmodified one. In such a case, do not modify the lines

```
SEQUENCE PP/S
```

to

```
END SEQUENCE
```

Rather, copy the block and modify the copy. Apart from modifying the D5 initialization line, however, change also the sequence name to something like

```
SEQUENCE PP/S_P6P7TauTrigger
```

Now you have got two distinct sequences which shall be both automatically recognized by the AcqNmr software.

It is actually a good idea to copy all such modified sequences into your own sequences library file, avoiding modifications to the default library (it changes with every software update!). For more details, see the runtime manual Chapter *Advanced Software Topics | Pulse sequence Scripts*.

V. Precautions and Warning

The intrinsic c-device can be used to activate **any** pulser channel, including the transmitter gate (T) and, in FFC, the channels reserved for magnet control (I and V). Unless you know exactly what you are doing, avoid using these letters within the c(...) pulser channels list. Inappropriate use might lead to a permanent damage of the instrument's hardware!

Of course, you have to use the T channel when programming sequences of the $T_{1\rho}$ type. Do so with care, making sure that the transmitter is gated ON only when you really need it to be ON! You do not need to think about the transmitter blanking channel (usually Z) since it is taken care of automatically according to the T-channel state.

Further reading

If the above explanations leave you doubtful and you wish to read more about these matters, display the runtime Manual, find *Intrinsic Device* in its keywords *Index* and select the associated topic *Pulser channels switch*. You should also read the topics *Intrinsic pulser-controlled devices* and *Parameter options syntax*.

Appendix

Complete list of pulser channels and their conventional assignments

Within the software, pulser channels are referred-to by the letters contained in the SSPC string parameter (the read-only parameter is located in parameters page *Acq.Par|Hard*). Its standard value is

SSPC = HTRRIVOMXFDSZ

The position of each letter (possibly repeated) in the SSPC string defines the physical AQM connector to which it is wired (see the table).

Whether the channel is active-low or active-high is defined by the corresponding character in the PCPM (pulser channels polarity mask) string parameter. The standard value of PCPM is

PCPM = LHHHHHHHLLHHL

Never modify these two parameters - they could be linked to your installations specific hardware!

Table
of standard assignments of software channel names to AQM channels

SSPC string offset	Software name ^a	AQM connector ^b	Note	FFC usage	SPM usage
0	H	P11	Free	Free	Free
1	T	P1 or TX	Transmitter gate	Caution	Caution
2	R	P2 or RX1	Receiver gate	Caution	Caution
3	R	P3 or RX2	Receiver gate	Caution	Caution
4	I	P4	In FFC, magnet control	NO!	Free
5	V	P5	In FFC, magnet control	NO!	Free
6	O	P6	Free (in HR, decoupler ON)	Free	Free
7	M	P7	Free (in HR, decoupler Mod)	Free	Free
8	X	P8	Phase increment (PINC)	NO!	NO!
9	F	Not available	AQM CPU flag	NO!	NO!
10	D	Not available	Special pulser ADC strobe	NO!	NO!
11	S	P9	Acquisition scan trigger	Caution	Caution
12	Z	P10	Tx blanking (TXEN)	NO!	NO!

^a In principal, the assignment of the various "logical" channels to the "physical outputs is User-specific, though we try to keep it standard. The letter "names" T,R,D and S have a specific pre-defined meaning within the Nmre software and the logical meaning of two other channels is specified by the parameters PINC (normally X) and TXEN (normally Z). In principal, all other letters could be changed without any effect on the executable files.

^b AQM connector P12 is not a pulser output. It is the dwell-time clock (DW50), active during acquisition scans intended for synchronization of external devices with acquisition strobes (example: homodecoupling in HRNMR).