DESC_FM.08F

```
; File name desc_fm.08f
; Descent sequence for GCMS FM
; Based on desc_fm.07f
; Modified by lf on 7 March 97
; to fix time problem at 1:46
; and put ACP column at 70 C rather than 80 C
; Modified again by c2 on 7 March 97
; to fix double valve ops on VS5 injections
;
; Modified 24 Feb 97 to correct VC1-3 settings
; and to prevent fractional scans during ACP measurement
;
; Start by enabling all relevant devices
; Two seconds are required for Descent > T0 to be detected.
;
;  Note that values for the Filament 1 and 2 Ionization Potential
; and for the GC sample selection thresholds are changed dynamically
; within the sequence and may not match the values in the AMB
;
; Modified for 30,30,40 GC temps except 60 for ACP
;
0:00:00     valve IV enable
0:00:00     valve IVA enable
0:00:00     valve VAA enable
0:00:00     valve VAB enable
0:00:00     valve VC1 enable
0:00:00     valve VC2 enable
0:00:00     valve VC3 enable
0:00:00     valve VD1 enable
0:00:00     valve VD2 enable
0:00:00     valve VD3 enable
0:00:00     valve VD4 enable
0:00:00     valve VX enable
0:00:00     valve VD6 enable
0:00:00     valve VE enable
0:00:00     valve VG enable
0:00:00     valve VG1 enable
0:00:00     valve VG2 enable
0:00:00     valve VG3 enable
0:00:00     valve VL1 enable
0:00:00     valve VL2 enable
0:00:00     valve VL3 enable
0:00:00     valve VL4 enable
0:00:00     valve VS1 enable
0:00:00     valve VS2 enable
```

```
0:00:00     valve VS3 enable
0:00:00     valve VS5 enable
0:00:00     valve VS6 enable
0:00:00     valve VS7 enable
0:00:00     valve VV enable
0:00:00     valve VZ enable
0:00:00     heater inlet enable
0:00:00     heater cell_1 enable
; No Cell_2 any more
0:00:00     heater cell_2 disable
0:00:00     heater acp_line enable
0:00:00     heater mass_source_cal disable
;
; Don't enable GC heaters yet.  Enabling starts temp control, i.e. turns them on
0:00:00     heater gc_oven_1 disable
0:00:00     heater gc_oven_2 disable
0:00:00     heater gc_oven_3 disable
;
0:00:00     filament_ctrl filament1 enable
0:00:00     filament_ctrl filament2 enable
0:00:00     filament_ctrl filament3 enable
0:00:00     filament_ctrl filament4 enable
0:00:00     filament_ctrl filament5 enable
; No BA
0:00:00     filament_ctrl filament6 disable
0:00:00     ipump one_two_and_three enable
0:00:00     ipump four_five_and_six enable
; Enable all Ion Sources
0:00:00     isource false round_robin 0 1 1 1 1 1 0
; But only activate Direct for scans
; until just before the GCs start
0:00:00     isource true round_robin 0 1 0 0 0 0 0
; Start doing fractional scans once every 32 * 10 scans (5 min 7.17 sec)
0:00:00     useq_ctrl alt_step direct 0 0 32 1
;
; Turn on first set of Ion Pumps (were on during pre-T0, so no big burst expected)
0:00:00     ipump one_two_and_three on
0:00:00     No_op
0:00:00     No_op_L2
; Do first valve ops
0:00:00     valve VL1 close
0:00:01     valve VD1 open
0:00:02     valve VL2 close
0:00:03     valve VD2 open
0:00:04     valve VL4 close
```

```
0:00:05     valve VV open
0:00:06     valve VX close
; Interleave other device turnons with further valve ops
;           0:00:00     ISs ON
0:00:07     ipump four_five_and_six on
0:00:08     valve VC1 open
0:00:09     filament_ctrl filament1 on
0:00:10     valve VC2 open
0:00:11     filament_ctrl filament2 on
0:00:12     valve VC3 open
0:00:13     filament_ctrl filament3 on
0:00:14     valve VZ close
0:00:15     filament_ctrl filament4 on
0:00:16     valve VS7 close
0:00:17     filament_ctrl filament5 on
0:00:18     valve VE close
; No protected power yet, but turn off anyway
0:00:19     heater acp_line off
; Inlet (and H2) heaters on
0:00:20     valve VL3 close
0:00:21     heater cell_1 off
0:00:22     valve VD3 close
0:00:23     heater inlet on
0:00:24     valve VD4 close
0:00:25     No_op
0:00:26     valve VS6 close
0:00:27     No_op
0:00:28     valve VS5 close
0:00:29     No_op
0:00:30     valve VG1 close
0:00:31     No_op
0:00:32     valve VG2 close
0:00:33     No_op
0:00:34     valve VG3 close
0:00:35     No_op
0:00:36     valve VS1 close
0:00:37     No_op
0:00:38     valve VS2 close
0:00:39     No_op
0:00:40     valve VS3 close
0:00:41     valve VD6 open
0:00:42     valve VG close
0:00:43     No_op
0:00:44     valve VAA close
0:00:45     No_op
```

```
0:00:46     valve VAB close
0:00:50     No_op
0:00:50     No_op_L2
;
;  Inlet pyros fire at 50 seconds
;
0:00:52     valve VZ open
0:00:53     No_op
;
;  Outlet pyros fire at 53 seconds
;
0:00:54     valve VZ open
0:00:55     valve VG1 close
0:00:56     valve VL1 open
0:00:57     heater inlet on
0:00:58     valve VL1 open
0:00:59     valve VG1 close
0:01:00     valve VD6 open
;
; About every 5 minutes, make sure Inlet and IPs have not
; been turned off by overcurrent
;
0:05:00 ipump four_five_and_six on
0:05:20 ipump one_two_and_three on
0:05:30 heater inlet on
;
0:10:00 ipump one_two_and_three on
0:10:20 ipump four_five_and_six on
0:10:30 heater inlet on
0:10:31     No_op
0:10:32     No_op_L2
;
0:15:00 ipump four_five_and_six on
0:15:20 ipump one_two_and_three on
0:15:30 heater inlet on
; Do some redundant valve configuration
0:15:30     valve VC1 open
0:15:32     valve VD1 open
0:15:34     valve VC2 open
0:15:38     valve VD2 open
0:15:42     valve VC3 open
0:15:46     valve VV open
0:15:52     valve VX close
0:15:54     No_op
0:15:56     valve VL4 close
```

```
0:15:58     No_op
0:16:00     valve VL2 close
0:16:04     valve VL1 open
0:16:06     No_op
0:16:08     valve VZ open
0:16:12     valve VS7 close
0:16:14     No_op
0:16:16     valve VE close
0:16:18     No_op
0:16:20     valve VL3 close
0:16:22     No_op
0:16:24     valve VD3 close
0:16:26     No_op
0:16:28     valve VD4 close
0:16:30     No_op
0:16:32     valve VS6 close
0:16:34     No_op
0:16:36     valve VS5 close
0:16:38     No_op
0:16:40     valve VG1 close
0:16:42     No_op
0:16:44     valve VG2 close
0:16:46     No_op
0:16:48     valve VG3 close
0:16:50     No_op
0:16:52     valve VS1 close
0:16:54     No_op
0:16:56     valve VS2 close
0:16:58     No_op
0:17:00     valve VS3 close
0:17:04     valve VD6 open
0:17:08     valve VG close
0:17:10     No_op
0:17:12     valve VAA close
0:17:14     No_op
0:17:16     valve VAB close
;
;
0:20:00 ipump one_two_and_three on
0:20:20 ipump four_five_and_six on
0:20:30 heater inlet on
0:20:31     No_op
0:20:32     No_op_L2
;
0:24:50     valve VL3 close
```

```
0:24:51     valve VV open
0:24:52     valve VL3 close
0:24:53     valve VE open
0:24:54     valve VG close
0:24:55     valve VV open
0:24:56     valve VG close
0:24:58     valve VE open
0:25:00     valve VS7 open
0:25:02     valve VL3 close
0:25:03     valve VS7 open
0:25:45     valve VS7 close
0:25:47     valve VS7 close
;
0:25:49     valve VV close
0:25:50     valve VG open
0:25:51     valve VV close
0:25:52     valve VG open
;
0:26:00 ipump four_five_and_six on
0:26:20 ipump one_two_and_three on
0:26:30 heater inlet on
;
0:28:00     valve VE close
;XX         0:28:00     HE ON
; No Protected Power yet, but will ensure that heater is on when
; power is applied.
0:28:00     heater cell_1 on
0:28:02     valve VE close
;XX         0:28:02     HE ON
0:28:03     No_op
0:28:04     No_op_L2
;
0:28:34     valve VD1 close
0:28:36     valve VD4 close
0:28:37     valve VD2 open
0:28:38     valve VD3 close
0:28:40     valve VG3 close
0:28:42     valve VG2 close
; xs 0:28:44              valve VG1 close
0:28:46     valve VX close
0:28:48     valve VS5 close
0:28:50     valve VS1 close
0:28:52     valve VS2 close
0:28:54     valve VS3 close
0:28:56     valve VS6 close
```

```
;0:29:00 Protected Power turns on
0:28:58      valve VD1 close
0:29:00      valve VD4 close
0:29:01      valve VD2 open
0:29:02      valve VD3 close
0:29:04      valve VG3 close
0:29:06      valve VG2 close
0:29:08      valve VL1 close
0:29:10      valve VL1 close
;;;; start H2 flow
;
;
; Do H2 rupture valve operation !
; Allow four seconds rather than two, for extra
; energy
; Insert no_ops in case it is catch-up mode
0:29:12      No_op
0:29:13      No_op_L2
0:29:14      valve IV close
0:29:15      No_op
0:29:16      No_op_L2
0:29:17      No_op
0:29:18      valve IV close
0:29:19      valve IV open
0:29:20      No_op
0:29:21      No_op
0:29:22      No_op_L2
0:29:23      valve IV open
;
;
0:29:24 valve VS5 close
0:29:25 valve VD3 open
0:29:26 valve VS1 close
0:29:27 valve IV open
0:29:28 valve VS2 close
0:29:29 valve VD3 open
0:29:30 valve VS3 close
0:29:32 valve VS6 close
0:29:34 valve VD3 close
0:29:35 valve VD4 open
0:29:36 valve VD3 close
0:29:37 valve VD1 open
0:29:39 valve VD4 open
0:29:41 valve VD1 open
0:29:52 valve VL4 close
```

```
0:29:54 valve VL2 close
0:29:56 valve VL3 close
;
0:29:58      valve VS7 close
0:30:00      valve VZ close
0:30:02      valve VZ close
0:30:04      valve VX open
0:30:06      valve VX open
;
;
0:30:10 ipump one_two_and_three on
0:30:20 ipump four_five_and_six on
0:30:30 heater inlet on
0:30:31      No_op
0:30:32      No_op_L2
;
0:31:18      valve VG close
0:31:20      valve VG close
; XS 0:31:22              valve VV close
0:31:24      valve VE close
;XX          0:31:24      HE ON
; EC1 heater already on, has been powered for 2:24 minutes
0:31:24      heater cell_1 on
0:31:26      valve VV close
; XS 0:31:28              valve VE close
;XX          0:31:28      HE ON
0:31:28      heater cell_1 on
0:31:29      valve VL3 open
0:31:30      valve VG close
0:31:30      heater cell_1 on
;XX          0:31:30      HE ON
0:31:32      valve VL3 open
;
0:32:56      valve VV close
;XX          0:32:56      HE ON
; Still on.  Powered for 3:56 minutes so far
0:33:00      heater cell_1 on
0:33:00      valve VE open
0:33:01      valve VV close
0:33:02      valve VE open
0:33:30 heater cell_1 on
;
0:33:40      valve VC1 open
0:33:42      valve VD1 open
0:33:44      valve VC2 open
```

```
0:33:46     valve VD2 open
0:33:48     valve VC3 open
0:33:50     valve VD4 open
;
0:33:57     valve IV open
0:33:58     valve VS6 close
0:34:01 heater cell_1 on
; xs 0:34:02              valve VS5 close
; xs 0:34:04              valve VG3 close
; xs 0:34:06              valve VG2 close
; xs 0:34:08              valve VG1 close
0:34:10     valve VD3 close
0:34:12     valve VL1 close
0:34:14     valve VZ close
0:34:16     valve VL2 close
0:34:18     valve VS7 close
0:34:20     valve VL4 close
0:34:22     valve VS1 close
0:34:24     valve VS2 close
0:34:26     valve VS3 close
; xs 0:34:28              valve VV close
0:34:30     valve VL3 close
0:34:31     valve VG open
;XX         0:34:30     HE OFF
; Turned off after 5:30 of powered time
;
0:34:31     heater cell_1 off
0:34:32     valve VL3 close
0:34:33     valve VG open
;XX         0:34:32     HE OFF
0:34:33     heater cell_1 disable
0:34:34     valve VE close
0:34:36     valve VE close
;
;
; Prepare for ACP line opening
;
0:34:55     valve VAA open
0:34:56     No_op
0:34:57     valve VAA open
;
; Perform IVA rupture !
; (4 second charge time)
;
; Use No_ops to space in case of catch-up
```

```
0:34:58     No_op
0:34:59     No_op_L2
0:35:00     valve IVA close
0:35:01     No_op
0:35:02     No_op_L2
0:35:03     No_op
0:35:04     valve IVA close
0:35:05     valve IVA open
0:35:06     No_op
0:35:07     No_op_L2
0:35:08     No_op
0:35:09     valve IVA open
;
;XX         0:35:00     HA ON
;XX         0:35:00     HS ON
0:35:10     heater acp_line on
0:35:11     valve VAB open
;XX         0:35:04     HA ON
;XX         0:35:04     HS ON
0:35:13     heater acp_line on
0:35:15     valve VAB open
0:35:16     No_op
0:35:17     No_op_L2
0:35:18     valve IVA open
;
0:35:20     valve VL1 close
0:35:22     valve VE close
0:35:23     valve VG open
0:35:24     valve VL3 close
0:35:25     valve VAA open
0:35:26     valve VL4 close
0:35:27     valve VAB open
0:35:29     valve VC1 open
0:35:31     valve VD6 open
0:35:33     valve VC2 open
0:35:35     valve VD1 open
0:35:37     valve VC3 open
0:35:39     valve VD2 open
;
0:35:46     valve VG1 close
;
0:35:58     valve VV close
0:36:00     valve VL2 open
;
0:36:00     heater inlet on
```

```
; Already on, has been for 48 seconds
;XX          0:36:00      GC Heaters ON (enabling enables temp control at
; default temperatures, stored in AMB PROM
;
0:36:00      heater gc_oven_1 enable
0:36:00      heater gc_oven_2 enable
0:36:00      heater gc_oven_3 enable
;
0:36:02      valve VL2 open
;XX          0:36:02      HS ON
;
0:36:10 ipump four_five_and_six on
0:36:20 ipump one_two_and_three on
0:36:30 heater inlet on
0:36:31      No_op
0:36:32      No_op_L2
;
0:37:58      valve VD4 open
; xs 0:37:59                valve VG1 close
0:38:00      valve VX open
0:38:01      valve VG2 close
0:38:02      valve VX open
0:38:03      valve VG3 close
0:38:10      valve VD2 open
0:38:11      valve VD1 close
0:38:12      valve VD2 open
0:38:14      valve VD4 open
0:38:15      valve VD1 close
0:38:16      valve VS5 open
0:38:21      valve VS5 close
0:38:23      valve VS5 close
0:38:25      valve VD3 open
0:38:30      valve VD3 close
0:38:31      valve VD1 open
0:38:32      valve VD3 close
0:38:33      valve VD1 open
;
0:38:40      valve VX open
0:38:41      valve VD3 close
0:38:42      valve VX open
0:38:43      valve VS5 close
0:38:44      valve VC1 open
;
0:38:46      valve VC2 open
;
```

```
0:38:48      valve VC3 open
;
; For one minute before the first GC injection, force sampling of all
; columns and Direct
;
; Don't do Direct fractional sweeps until after 5 minutes of
; GC analysis
;
0:38:52 valve VD6 close
0:38:54 valve VD6 close
;
0:38:58 valve VG3 close
0:39:00 valve VS3 open
0:39:02 valve VS3 open
;
0:39:25 useq_ctrl alt_step direct 0 0 0 0
; Enable GCs for sampling along with Direct
0:39:28      isource true round_robin 0 1 0 1 1 1 0
;
0:39:30 valve VS3 close
0:39:34 valve VS3 close
0:39:37 valve VD6 close
;
0:39:41 valve VS1 close
;            GC Heaters ON (re-enable)
0:39:41      heater gc_oven_1 enable
0:39:41      heater gc_oven_2 enable
0:39:41      heater gc_oven_3 enable
;
0:39:44 valve VS2 close
;
0:39:48 valve VS6 close
0:39:49 valve VX open
0:39:50 valve VD1 close
;
0:39:52 valve VD1 close
0:39:53 valve VD3 open
0:39:54 valve VD2 close
;
; Give GC priority over Direct
;
0:39:55      valve VD3 open
0:39:55 isource true round_robin 0 1 0 1 1 1 0
;
;
```

```
0:39:56      valve VD2 close
0:39:57      valve VS3 open
0:39:58 valve VD4 close
0:39:59      No_op
0:39:59      No_op_L2
; One second "non-squirt" injection
0:40:00      valve VG3 open
;
; Start doing fractional scans once every 32 * 10 scans (5 min 7.17 sec)
0:40:00      useq_ctrl alt_step direct 0 0 32 1
0:40:00      No_op
0:40:00      No_op_L2
0:40:01      valve VG3 close
0:40:01      No_op
0:40:02      valve VD4 open
0:40:04      valve VG3 close
0:40:06      valve VS3 close
0:40:07      valve VD4 open
0:40:08      valve VD3 close
0:40:09      valve VD2 open
0:40:10      valve VS3 close
0:40:11      valve VD2 open
0:40:12      valve VD3 close
0:40:13      valve VD1 open
0:40:14      valve VS3 close
0:40:15      valve VD1 open
;
0:40:30 ipump one_two_and_three on
0:40:40 ipump four_five_and_six on
0:40:50 heater inlet on
;
;
;
0:45:00 ipump four_five_and_six on
0:45:20 ipump one_two_and_three on
0:45:30 heater inlet on
;
0:50:00 ipump one_two_and_three on
0:50:20 ipump four_five_and_six on
0:50:30 heater inlet on
0:50:31      No_op
0:50:32      No_op_L2
;
; xs 0:52:26                valve VG2 close
0:52:28      valve VG2 close
```

```
0:52:30     valve VS2 open
0:52:32     valve VS2 open
0:53:00     valve VS2 close
0:53:02 valve VS2 close
; Enable GCs for sampling along with Direct
0:53:03     isource true round_robin 0 1 0 1 1 1 0
;
0:53:13     valve VS2 close
;
0:53:18 No_op
0:53:19     valve VS6 close
0:53:20     valve VX open
0:53:21     valve VD1 close
;
0:53:23 valve VD1 close
0:53:24 valve VD3 open
0:53:25 valve VD2 close
; Give GC priority over Direct
;
0:53:25 isource true round_robin 0 1 0 1 1 1 0
;
;
0:53:26     valve VD3 open
0:53:27     valve VD2 close
0:53:28     valve VS2 open
0:53:29 valve VD4 close
;
; Don't do Direct fractional sweeps during first 5 minutes of
; GC analysis
;
0:53:29 useq_ctrl alt_step direct 0 0 0 0
; One second "non-squirt"
0:53:30     valve VG2 open
0:53:31 valve VG2 close
; Start doing fractional scans once every 32 * 10 scans (5 min 7.17 sec)
0:53:31     useq_ctrl alt_step direct 0 0 32 1
0:53:32 valve VD4 open
0:53:34     valve VG2 close
0:53:36     valve VS2 close
0:53:37     valve VD4 open
0:53:38     valve VD3 close
0:53:39     valve VD2 open
0:53:40     valve VS2 close
0:53:41     valve VD2 open
0:53:42     valve VD3 close
```

```
0:53:43      valve VD1 open
0:53:44      valve VS1 close
0:53:45 valve VD1 open
;
;
0:55:00 ipump four_five_and_six on
0:55:20 ipump one_two_and_three on
0:55:30 heater inlet on
;
;
;XX          0:59:00      HA ON
0:59:00      heater acp_line on
;
1:00:00 ipump one_two_and_three on
1:00:20 ipump four_five_and_six on
1:00:30 heater inlet on
1:00:31      No_op
1:00:32      No_op_L2
;
;
1:03:00      valve VAA open
;
1:04:00      valve VAA close
1:04:02      valve VAA close
1:04:04      valve VAB close
1:04:06      valve VAB close
;;;;;;
; Stop Direct for ACP-only sampling
1:04:46      isource true round_robin 0 0 1 0 0 0 0
; Note that GCs are disabled for non-GC ACP sample
;
; Don't do fractionals during ACP
1:04:46 useq_ctrl alt_step direct 0 0 0 0
;
1:04:56      valve VL4 open
;XX          1:04:56      open SYNC WINDOW
1:04:56      acp_window 1
; Redundant VL4 removed
1:04:58      No_op
;
; Rest of sequence is controlled by ACP sync
; Approximate times are shown, but commands are
; commented out
;1:05:01     valve VAB open  Sync pulse 1
;1:05:01.875              valve VAB close
```

```
;1:05:06.625          valve VAB open  Sync pulse 2
;1:05:07.500          valve VAB close
;1:05:12.250          valve VAB open  Sync pulse 3
;1:05:13.125          valve VAB close
;1:05:17.875          valve VAB open  Sync pulse 4
;1:05:18.750          valve VAB close
;1:05:23.500          valve VAB open  Sync pulse 5
;1:05:24.375          valve VAB close
;1:05:29.125          valve VAB open  Sync pulse 6
;1:05:30.000          valve VAB close
;1:05:35.750          valve VAA open
;1:05:40.750          valve VAA close
;1:05:43.875          valve VAB open   Sync pulse 7
;1:05:44.625          valve VAB close
;1:05:49.500          valve VAB open  Sync pulse 8
;1:05:50.250          valve VAB close
;1:05:56.375          valve VAA open
;1:06:01.375          valve VAA close
;XX         1:06:05     close SYNC WINDOW
1:06:10     acp_window 0
1:06:10     valve VL4 close
; Start including Direct and GCs in sampling
1:06:10     isource true round_robin 0 1 1 1 1 1 0
;
1:06:12     valve VL4 close
;
1:06:20 ipump four_five_and_six on
1:06:30 ipump one_two_and_three on
1:06:40 heater inlet on
1:06:41     No_op
1:06:42     No_op_L2
;
;
; Stop Direct for ACP-only sampling
1:07:46     isource true round_robin 0 0 1 0 0 0 0
; Note that GCs are also disabled for non-GC ACP sample
;
; Start raising GC3 temperature to 70 C
1:07:50     cmp FC82 00E5
1:07:50     cmp FC85 00E5
;
1:07:56     valve VL4 open
;XX         1:07:56     open SYNC WINDOW for 250 C sample
1:07:56     acp_window 1
; Redundant VL4 removed
```

```
1:07:58     No_op
; Rest of sequence is controlled by ACP sync
; Approximate times are shown, but commands are
; commented out
;1:08:01    valve VAB open  Sync pulse 9
;1:08:01.875            valve VAB close
;1:08:06.625            valve VAB open  Sync pulse 10
;1:08:07.500            valve VAB close
;1:08:12.250            valve VAB open  Sync pulse 11
;1:08:13.125            valve VAB close
;1:08:17.875            valve VAB open  Sync pulse 12
;1:08:18.750            valve VAB close
;1:08:23.500            valve VAB open  Sync pulse 13
;1:08:24.375            valve VAB close
;1:08:29.125            valve VAB open  Sync pulse 14
;1:08:30.000            valve VAB close
;
; At about this time, change to low ionization potential for ACP source
; (after 6th transfer but before venting)
1:08:27 cmp FFA9 000E
1:08:27 cmp FFAA 0000
;
;1:08:35.750            valve VAA open
; At about this time, change back to high ionization potential
1:08:40 cmp FFA9 00EE
1:08:40 cmp FFAA 00E0
;
;1:08:40.750            valve VAA close
;1:08:43.875            valve VAB open  Sync pulse 15
;1:08:44.625            valve VAB close
;1:08:49.500            valve VAB open  Sync pulse 16
;1:08:50.250            valve VAB close
;1:08:56.375            valve VAA open
;1:09:01.375            valve VAA close
;XX         1:09:05     close SYNC WINDOW
1:09:05     acp_window 0
1:09:10     valve VL4 close
;
; Enable GCs for sampling along with Direct
1:09:10     isource true round_robin 0 1 1 1 1 1 0
;
;
1:10:00 ipump one_two_and_three on
1:10:20 ipump four_five_and_six on
1:10:30 heater inlet on
```

```
; Force sampling of GCs to get backgrounds
; Start including Direct and GCs in sampling
;
; Start ACP and GC sampling for upcoming ACP injection
; Keep ACP in samping loop but no Direct
;
; Give GC priority over ACP
;
1:12:55 isource true round_robin 0 0 1 1 1 1 0
;
;
1:12:56     valve VL4 open
;XX         1:12:56     open SYNC WINDOW
1:12:56     acp_window 1
; Redundant VL4 removed
1:12:58     No_op
; Rest of sequence is controlled by ACP sync
; Approximate times are shown, but commands are
; commented out
;1:13:01    valve VAB open  Sync pulse 17
;1:13:01.875            valve VAB close
;1:13:06.625            valve VAB open  Sync pulse 18
;1:13:07.500            valve VAB close
;1:13:08.625            valve VS6 squirt 4 (100 msec)
;1:13:08.725            valve VS6 close (from squirt)
;1:13:12.250            valve VAB open  Sync pulse 19
;1:13:13.125            valve VAB close
;1:13:17.875            valve VAB open  Sync pulse 20
;1:13:18.750            valve VAB close
;1:13:23.500            valve VAB open  Sync pulse 21
;1:13:24.375            valve VAB close
;1:13:29.125            valve VAB open  Sync pulse 22
;1:13:30.000            valve VAB close
;1:13:35.750            valve VAA open
;1:13:40.750            valve VAA close
;1:13:43.875            valve VAB open  Sync pulse 23
;1:13:44.625            valve VAB close
;1:13:49.500            valve VAB open  Sync pulse 24
;1:13:50.250            valve VAB close
;1:13:56.375            valve VAA open
;1:14:01.375            valve VAA close
;XX         1:14:05     close SYNC WINDOW
1:14:05     acp_window 0
; Bring Direct back in, but keep ACP for a few minutes to
; catch any residual
```

```
1:14:05 isource true round_robin 0 1 1 1 1 1 0
;
; Start doing fractionals on Direct again
1:14:05     useq_ctrl alt_step direct 0 0 32 1
;
1:14:10     valve VL4 close
1:14:12     valve VL4 close
1:14:14     valve VAA close
1:14:16     valve VAA close
1:14:18     valve VAB close
1:14:20     valve VAB close
;
1:15:00 ipump four_five_and_six on
1:15:20 ipump one_two_and_three on
1:15:30 heater inlet on
1:15:31     No_op
1:15:32     No_op_L2
;
;
; Stop samping ACP
1:20:00 isource true round_robin 0 1 0 1 1 1 0
1:20:00 ipump one_two_and_three on
1:20:20 ipump four_five_and_six on
1:20:30 heater inlet on
;
;
; Start lowering GC3 temperature back to 40 C
1:23:00     cmp FC82 01D3
1:23:00     cmp FC85 01D3
;
;
1:25:00 ipump four_five_and_six on
1:25:20 ipump one_two_and_three on
1:25:25 heater inlet on



; xs 1:25:26              valve VG3 close
1:25:28     valve VG1 close
1:25:30     valve VS1 open
1:25:32     valve VS1 open
1:26:00     valve VS1 close
1:26:02     valve VS1 close
1:26:03     No_op
1:26:03     No_op_L2
```

```
; xs 1:26:09              valve VG3 close
1:26:11     valve VS1 close
;XX         1:26:11     GC Heaters ON
1:26:12     heater gc_oven_1 enable
1:26:12     heater gc_oven_2 enable
1:26:12     heater gc_oven_3 enable
1:26:13     valve VS2 close
1:26:15     valve VS3 close
1:26:17     valve VS5 close
1:26:19     valve VS6 close
1:26:20     valve VX open
1:26:21 valve VD1 close
; Don't do fractionals during first 5 min of GC
1:26:21 useq_ctrl alt_step direct 0 0 0 0
; Give GC priority over direct
;
1:26:21 isource true round_robin 0 1 0 1 1 1 0
;
; Put GC thresholds back
;
; xs 1:26:22              valve VX open
1:26:23     valve VD1 close
1:26:24 valve VD3 open
1:26:25     valve VD2 close
1:26:26     valve VD3 open
1:26:27     valve VD2 close
1:26:28     valve VS1 open
1:26:29     valve VD4 close
; "Non-squirt" one second injection
1:26:30     valve VG1 open
1:26:30 No_op
1:26:30 No_op_L2
1:26:31     valve VG1 close
1:26:32     valve VD4 open
1:26:34     valve VG1 close
1:26:36     valve VS1 close
1:26:37     valve VD4 open
1:26:38     valve VD3 close
1:26:39     valve VD2 open
1:26:40     valve VS3 close
1:26:41     valve VD2 open
1:26:42     valve VD3 close
1:26:43     valve VD1 open
; xs 1:26:44              valve VS1 close
1:26:45     valve VD1 open
```

```
;
1:30:00 ipump one_two_and_three on
1:30:20 ipump four_five_and_six on
1:30:30 heater inlet on
;
;XX          1:33:00      HA ON
1:33:00      heater acp_line on
;XX          1:33:10      HA ON
1:33:10      heater acp_line on
;
1:35:00 ipump four_five_and_six on
1:35:20 ipump one_two_and_three on
1:35:30 heater inlet on
1:35:31      No_op
1:35:32      No_op_L2
;
1:37:00      valve VAA open
1:37:02      valve VAA open
; Don't do fractionals during ACP
1:37:10 useq_ctrl alt_step direct 0 0 0 0
;
1:38:00      valve VAA close
1:38:02      valve VAA close
1:38:04      valve VAB close
1:38:06      valve VAB close
;
; Stop Direct for ACP-only sampling
1:38:55      isource true round_robin 0 0 1 0 0 0 0
; Note that GCs are disabled for non-GC ACP sample
;
1:38:56      valve VL4 open
;XX          1:38:56      open SYNC WINDOW
1:38:56      acp_window 1
; Redundant VL4 removed
1:38:58      No_op
;1:39:01     valve VAB open
;1:39:02     valve VAB close
;1:39:06     valve VAB open
;1:39:07     valve VAB close
;1:39:11     valve VAB open
;1:39:12     valve VAB close
;1:39:16     valve VAB open
;1:39:17     valve VAB close
;1:39:21     valve VAB open
;1:39:22     valve VAB close
```

```
;1:39:26     valve VAB open
;1:39:27     valve VAB close
;1:39:35     valve VAA open
;1:39:40     valve VAA close
;1:39:43     valve VAB open
;1:39:44     valve VAB close
;1:39:49     valve VAB open
;1:39:50     valve VAB close
;1:39:56     valve VAA open
;1:40:01     valve VAA close
;XX          1:40:05      close SYNC WINDOW
1:40:05      acp_window 0
;
1:40:10      valve VL4 close
; Start including Direct and GCs in sampling
1:40:10      isource true round_robin 0 1 1 1 1 1 0
1:40:12      valve VL4 close
;
1:40:20 ipump one_two_and_three on
1:40:40 ipump four_five_and_six on
1:40:50 heater inlet on
1:41:30 No_op
1:41:31 No_op_L2
;
; Stop Direct for ACP-only sampling
1:41:55      isource true round_robin 0 0 1 0 0 0 0
;
1:41:56      valve VL4 open
;XX          1:41:56      open SYNC WINDOW
1:41:56      acp_window 1
; Redundant VL4 removed
1:41:58      No_op
;1:42:01     valve VAB open
;1:42:02     valve VAB close
;1:42:06     valve VAB open
;1:42:07     valve VAB close
;1:42:11     valve VAB open
;1:42:12     valve VAB close
;1:42:16     valve VAB open
;1:42:17     valve VAB close
;1:42:21     valve VAB open
;1:42:22     valve VAB close
;1:42:26     valve VAB open
;1:42:27     valve VAB close
; Change ACP to low ionization potential
```

```
1:42:27 cmp FFA9 000E
1:42:27 cmp FFAA 0000
;
;1:42:29     valve VAB close
; Change back to High ionization potential
1:42:34 cmp FFA9 00EE
1:42:34 cmp FFAA 00E0
;
;1:42:35     valve VAA open
;1:42:40     valve VAA close
;1:42:43     valve VAB open
;1:42:44     valve VAB close
;1:42:49     valve VAB open
;1:42:50     valve VAB close
;1:42:56     valve VAA open
;1:43:01     valve VAA close
;XX          1:43:05      close SYNC WINDOW
1:43:05      acp_window 0
;
;
1:43:10      valve VL4 close
; Start including Direct and GCs in sampling
1:43:10      isource true round_robin 0 1 1 1 1 1 0
;
1:43:12      valve VL4 close
;
1:45:00 ipump four_five_and_six on
1:45:20 ipump one_two_and_three on
1:45:30 heater inlet on
1:45:31      No_op
1:45:32      No_op_L2
;
; xs 1:46:10                valve VS5 close
1:46:11      valve VD1 open
1:46:12      valve VS6 close
1:46:13      valve VD2 open
1:46:14      valve VD3 close
1:46:15      valve VD4 open
1:46:16      valve VS1 close
1:46:17      valve VC1 open
; xs 1:46:18                valve VS2 close
1:46:19      valve VC2 open
1:46:20      valve VS3 close
1:46:21      valve VC3 open
1:46:22      valve VG1 close
```

```
1:46:23     valve VL2 open
1:46:24     valve VG2 close
; xs 1:46:25             valve VX open
1:46:26     valve VG3 close
1:46:28     valve VL1 close
1:46:30     valve VZ close
1:46:32     valve VS7 close
; xs 1:46:34             valve VE close
1:46:36     valve VL3 close
;
;
; Stop Direct for ACP-only sampling
1:46:55     isource true round_robin 0 0 1 0 0 0 0
;
1:46:56     valve VL4 open
;XX         1:46:56     open SYNC WINDOW
1:46:56     acp_window 1
; Redundant VL4 removed
1:46:58     No_op
;1:47:01    valve VAB open
;1:47:01.875            valve VAB close
;1:47:06.625            valve VAB open
;1:47:07.500            valve VAB close
;1:47:12.250            valve VAB open
;1:47:13.125            valve VAB close
;1:47:17.875            valve VAB open
;1:47:18.750            valve VAB close
;1:47:23.500            valve VAB open
;1:47:24.375            valve VAB close
;1:47:29.125            valve VAB open
;1:47:30.000            valve VAB close
;1:47:35.750            valve VAA open
;1:47:40.750            valve VAA close
;1:47:43.875            valve VAB open
;1:47:44.750            valve VAB close
;1:47:49.500            valve VAB open
;1:47:50.375            valve VAB close
;1:47:56.125            valve VAA open
;1:48:01.125            valve VAA close
;XX         1:48:05     close SYNC WINDOW
1:48:05     acp_window 0
;
;XX         1:48:05     HA OFF
;
1:48:05     isource true round_robin 0 1 1 1 1 1 0
```

```
; Force sampling of GCs to get backgrounds
; Start including Direct and GCs in sampling
; Set all GC select thresholds to 0
;
1:48:06 No_op
1:48:06 No_op_L2
1:48:07      valve VL4 close
1:48:08      valve VAA open
1:48:09      valve VS6 close
1:48:10      valve VAA open
1:48:11      valve VL4 close
; XS 1:48:13              valve VS6 close
1:48:15      valve VAA close
1:48:17      valve VAA close
;
;
1:48:19      isource true round_robin 0 1 0 1 1 1 0
;
; BEGIN MODIFIED SECTION (NOW to END)
;
1:48:20      valve VD3 close
1:48:21      valve VX open
; End of ACP sampling.  Turn off heater and deselect source
1:48:21      heater acp_line off
; Turn off filament
1:48:21 filament_ctrl filament2 off
1:48:22      valve VS5 close
1:48:24      valve VD2 close
1:48:26      valve VD1 close
1:48:28      valve VD4 close
1:48:29      valve VD3 open
1:48:30      valve VD3 close
1:48:31      valve VS5 open
1:48:32      valve VS5 close
1:48:33      valve VD2 open
1:48:35      valve VD3 open
1:48:36      valve VD3 close
1:48:37      valve VD4 open
1:48:38      valve VD3 close
1:48:39      valve VD1 open
1:48:40      valve VS5 close
1:48:41      valve VD2 open
1:48:42      valve VS5 close
1:48:43      valve VD2 open
1:48:44      valve VD3 close
```

```
1:48:46      valve VD1 open
;
; Re-enable fractional scans
;
1:48:50 useq_ctrl alt_step direct 0 0 32 1
;
1:50:00 ipump one_two_and_three on
1:55:20 ipump four_five_and_six on
1:55:30 heater inlet on
;
1:56:00      isource true round_robin 0 1 0 1 1 1 0
;
;
2:00:00 ipump one_two_and_three on
2:00:20 ipump four_five_and_six on
2:00:30 heater inlet on
;
; Following moved to one second earlier than titan008.csv to allow two second
; charge before squirt
2:01:17      valve VL2 open
2:01:18      valve VL1 close
2:01:19      valve VD1 open
2:01:20      valve VZ close
2:01:21      valve VD2 open
2:01:22      valve VS7 close
2:01:23      valve VD4 open
2:01:24      valve VE close
2:01:25      valve VC1 open
2:01:26      valve VL3 close
2:01:27      valve VC2 open
2:01:28      valve VS1 close
2:01:29      valve VC3 open
2:01:30      valve VS2 close
2:01:31      valve VX open
2:01:32      valve VS3 close
2:01:34      valve VS5 close
2:01:36      valve VL4 close
2:01:38      valve VS6 close
2:01:40      valve VG1 close
2:01:42      valve VG2 close
2:01:44      valve VG3 close
2:01:46      valve VD3 close
;
; Injection sequence
2:01:50      valve VD3 close
```

```
2:01:51     valve VX open
2:01:52     valve VS5 close
2:01:54     valve VD2 close
2:01:56     valve VD1 close
2:01:58     valve VD4 close
2:01:59     valve VD3 open
2:02:00     valve VD3 close
2:02:01     valve VS5 open
2:02:02     valve VS5 close
2:02:03     valve VD2 open
2:02:05     valve VD3 open
2:02:06     valve VD3 close
2:02:07     valve VD4 open
2:02:08     valve VD3 close
2:02:09     valve VD1 open
2:02:10     valve VS5 close
2:02:11     valve VD2 open
2:02:12     valve VS5 close
2:02:13     valve VD2 open
2:02:14     valve VD3 close
2:02:16     valve VD1 open
;
;
2:05:00 ipump four_five_and_six on
2:05:20 ipump one_two_and_three on
2:05:30 heater inlet on
;
;
2:10:00 ipump one_two_and_three on
2:10:20 ipump four_five_and_six on
2:10:30 heater inlet on
;
;
;Following moved to one second earlier
; xs 2:14:47          valve VL2 open
; xs 2:14:48          valve VL1 close
2:14:49     valve VD1 open
; xs 2:14:50          valve VZ close
2:14:51     valve VD2 open
; xs 2:14:52          valve VS7 close
2:14:53     valve VD4 open
; xs 2:14:54          valve VE close
; XS 2:14:55          valve VC1 open
; 2:14:56    valve VL3 close
; xs 2:14:57          valve VC2 open
```

```
; xs 2:14:58          valve VS1 close
; xs 2:14:59          valve VC3 open
; xs 2:15:00          valve VS2 close
; xs 2:15:01          valve VX open
2:15:02     valve VS3 close
2:15:04     valve VS5 close
2:15:06     valve VL4 close
2:15:08     valve VS6 close
; xs 2:15:10          valve VG1 close
; xs 2:15:12          valve VG2 close
; xs 2:15:14          valve VG3 close
2:15:16     valve VD3 close
;
; Injection sequence
2:15:20     valve VD3 close
2:15:21     valve VX open
2:15:22     valve VS5 close
2:15:24     valve VD2 close
2:15:26     valve VD1 close
2:15:28     valve VD4 close
2:15:29     valve VD3 open
2:15:30     valve VD3 close
2:15:31     valve VS5 open
2:15:32     valve VS5 close
2:15:33     valve VD2 open
2:15:35     valve VD3 open
2:15:36     valve VD3 close
2:15:37     valve VD4 open
2:15:38     valve VD3 close
2:15:39     valve VD1 open
2:15:40     valve VS5 close
2:15:41     valve VD2 open
2:15:42     valve VS5 close
2:15:43     valve VD2 open
2:15:44     valve VD3 close
2:15:46     valve VD1 open
;
;
;
2:16:00 ipump four_five_and_six on
2:16:20 ipump one_two_and_three on
2:16:30 heater inlet on
;
;
2:20:00 ipump one_two_and_three on
```

```
2:20:20 ipump four_five_and_six on
2:20:30 heater inlet on
;
;
2:25:00 ipump four_five_and_six on
2:25:20 ipump one_two_and_three on
2:25:30 heater inlet on
;
;Following moved to one second earlier
; xs 2:28:17              valve VL2 open
; xs 2:28:18              valve VL1 close
2:28:19     valve VD1 open
; xs 2:28:20              valve VZ close
2:28:21     valve VD2 open
; xs 2:28:22              valve VS7 close
2:28:23     valve VD4 open
; xs 2:28:24              valve VE close
2:28:25     valve VC1 open
; 2:28:26    valve VL3 close
2:28:27     valve VC2 open
; xs 2:28:28              valve VS1 close
2:28:29     valve VC3 open
; xs 2:28:30              valve VS2 close
; xs 2:28:31              valve VX open
; xs 2:28:32              valve VS3 close
2:28:34     valve VS5 close
; xs 2:28:36              valve VL4 close
2:28:38     valve VS6 close
; xs 2:28:40              valve VG1 close
; xs 2:28:42              valve VG2 close
; xs 2:28:44              valve VG3 close
2:28:46     valve VD3 close
;
; Injection sequence
;
2:28:50     valve VD3 close
2:28:51     valve VX open
2:28:52     valve VS5 close
2:28:54     valve VD2 close
2:28:56     valve VD1 close
2:28:58     valve VD4 close
2:28:59     valve VD3 open
2:29:00     valve VD3 close
2:29:01     valve VS5 open
2:29:02     valve VS5 close
```

2:29:03 valve VD2 open
2:29:05 valve VD3 open
2:29:06 valve VD3 close
2:29:07 valve VD4 open
2:29:08 valve VD3 close
2:29:09 valve VD1 open
2:29:10 valve VS5 close
2:29:11 valve VD2 open
2:29:12 valve VS5 close
2:29:13 valve VD2 open
2:29:14 valve VD3 close
2:29:16 valve VD1 open
;
;
2:30:00 ipump one_two_and_three on
2:30:20 ipump four_five_and_six on
2:30:30 heater inlet on
;
;
2:35:00 ipump four_five_and_six on
2:35:20 ipump one_two_and_three on
2:35:30 heater inlet on
;
;
2:40:00 ipump one_two_and_three on
2:40:20 ipump four_five_and_six on
2:40:30 heater inlet on
;
;Following moved to one second earlier
; xs 2:41:47 valve VL2 open
; xs 2:41:48 valve VL1 close
2:41:49 valve VD1 open
; xs 2:41:50 valve VZ close
2:41:51 valve VD2 open
; xs 2:41:52 valve VS7 close
2:41:53 valve VD4 open
; xs 2:41:54 valve VE close
; xs 2:41:55 valve VC1 open
; xs 2:41:56 valve VL3 close
; xs 2:41:57 valve VC2 open
; xs 2:41:58 valve VS1 close
; xs 2:41:59 valve VC3 open
; xs 2:42:00 valve VS2 close
; xs 2:42:01 valve VX open
; xs 2:42:02 valve VS3 close

```
2:42:04     valve VS5 close
; xs 2:42:06            valve VL4 close
2:42:08     valve VS6 close
; xs 2:42:10            valve VG1 close
; xs 2:42:12            valve VG2 close
; xs 2:42:14            valve VG3 close
2:42:16     valve VD3 close
;
; Injection sequence
2:42:20     valve VD3 close
2:42:21     valve VX open
2:42:22     valve VS5 close
2:42:24     valve VD2 close
2:42:26     valve VD1 close
2:42:28     valve VD4 close
2:42:29     valve VD3 open
2:42:30     valve VD3 close
2:42:31     valve VS5 open
2:42:32     valve VS5 close
2:42:33     valve VD2 open
2:42:35     valve VD3 open
2:42:36     valve VD3 close
2:42:37     valve VD4 open
2:42:38     valve VD3 close
2:42:39     valve VD1 open
2:42:40     valve VS5 close
2:42:41     valve VD2 open
2:42:42     valve VS5 close
2:42:43     valve VD2 open
2:42:44     valve VD3 close
2:42:46     valve VD1 open
;
;
2:45:00 ipump four_five_and_six on
2:45:20 ipump one_two_and_three on
2:45:30 heater inlet on
;
;
2:50:00 ipump one_two_and_three on
2:50:20 ipump four_five_and_six on
2:50:30 heater inlet on
;
;Following moved to one second earlier
; xs 2:55:17            valve VL2 open
; xs 2:55:18            valve VL1 close
```

2:55:19 valve VD1 open
; xs 2:55:20 valve VZ close
2:55:21 valve VD2 open
; xs 2:55:22 valve VS7 close
2:55:23 valve VD4 open
; xs 2:55:24 valve VE close
; xs 2:55:25 valve VC1 open
; xs 2:55:26 valve VL3 close
; xs 2:55:27 valve VC2 open
; xs 2:55:28 valve VS1 close
; xs 2:55:29 valve VC3 open
; xs 2:55:30 valve VS2 close
; xs 2:55:31 valve VX open
; xs 2:55:32 valve VS3 close
2:55:34 valve VS5 close
; xs 2:55:36 valve VL4 close
2:55:38 valve VS6 close
; xs 2:55:40 valve VG1 close
; xs 2:55:42 valve VG2 close
; xs 2:55:44 valve VG3 close
2:55:46 valve VD3 close
;
; Injection sequence
2:55:50 valve VD3 close
2:55:51 valve VX open
2:55:52 valve VS5 close
2:55:54 valve VD2 close
2:55:56 valve VD1 close
2:55:58 valve VD4 close
2:55:59 valve VD3 open
2:56:00 valve VD3 close
2:56:01 valve VS5 open
2:56:02 valve VS5 close
2:56:03 valve VD2 open
2:56:05 valve VD3 open
2:56:06 valve VD3 close
2:56:07 valve VD4 open
2:56:08 valve VD3 close
2:56:09 valve VD1 open
2:56:10 valve VS5 close
2:56:11 valve VD2 open
2:56:12 valve VS5 close
2:56:13 valve VD2 open
2:56:14 valve VD3 close
2:56:16 valve VD1 open

;
XXX