MODULE CONNECTOR

It has been proposed that changes should be made to the barrel module connector. These changes come under 4 headings.

- elimination of unused / unnecessary pins to save mass
- introduction of new pins eg sense lines
- change pin assignment
- change gender ie socket on opto-flex, plug on module

fig 1 represents the is the present situation, using a 36-pin connector, socket on module, plug on opto-flex.
3,4 are removed to prevent breakdown from bias.
pin 14 is used on the KEK hybrid, connected to pin 26.
pin 14 is not used on the dogleg -1 now being manufactured.

bias	2	1	bias
bias_ret	6	5	bias_ret
agnd	8	7	tempret
agnd	10	9	vcc
agnd	12	11	vcc
select	14	13	
com1b	16	15	com1
clk1b	18	17	clk1
dgnd	20	19	dgnd
vdd	22	21	vdd
dgnd	24	23	dgnd
select	26	25	reset
com0b	28	27	com0
clk0b	30	29	clk0
ledb	32	31	led
ledxb	34	33	ledx
temp2	36	35	temp1

fig 1

Multiple Connections

Pin 6. This is commoned with pin 5 for BIAS_RET. This could be regarded as redundant, yet I would recommend this redundancy should be kept. All other functions are such that a one-line failure would not result in the loss of a module: if select is lost the module uses the default i.e. normal setting, reset can be achieved by power cycling or command, the clocks and command have redundant versions and full module data can be read out through either led or ledx.
Multiple connections for AGND, VCC, DGND, VDD. Clearly redundancy is needed in the power lines for safety. It would take a braver man than I to suggest reducing the number of these pins.

Elimination of unused pins.

As a general principle, removal of unnecessary pins must be a good thing, in the interest of reducing mass. But it must be noted that unused pins can in any case be removed from connectors (this removal is already planned for pins 3 and 4 to give 450V capability to pins 1 and 2. If unused pins are removed, then the mass penalty is only that of the additional plastic. I'd like to note at this point that it is now being proposed that the connections between the Opto-Flex and the low-mass tapes as well as the redundancy arm connections should be by means of 2-part connectors, a total of 42 pin/receptacle pairs per module.
Pin 7, which was Vi1 and is now temp_ret. This pin is probably redundant, with the presently mooted scheme to use thermistors (high resistance) which are connected to DGND on the hybrid. Only 2 lines are needed to drive the thermistors, with DGND_SENSE being used as the common ground reference.
Pin 14 is redundant.
Pin 36, temp2. It has been proposed that the reset function and readout of temperature sensor 2 could be multiplexed on 1 line, the reset line, leaving temp2 unnecessary. A scheme for doing this has been designed by Ned Spencer .The benefit of this scheme is not just the elimination of a pin on the Opto-Flex, but also that it eliminates a track on the low-mass tape (less mass) and a conductor from the PP2-PP3 cable (less space?) Work has already started to evaluate the scheme at the System Test and this work will be completed the last week in June by Jan Stastny.

If the Reset/Temp2 scheme is approved, then on the present pinout there would be a total of 4 unused pins, as shown in fig 2

bias	2	1	bias
bias_ret	6	5	bias_ret
agnd	8	7	
agnd	10	9	vcc
agnd	12	11	vcc
	14	13	
com1b	16	15	com1
clk1b	18	17	clk1
dgnd	20	19	dgnd
vdd	22	21	vdd
dgnd	24	23	dgnd
select	26	25	reset
com0b	28	27	com0
clk0b	30	29	clk0
ledb	32	31	led
ledxb	34	33	ledx
	36	35	temp1

fig 2

Oxford proposal

bias	2	1	bias
bias_ret	6	5	bias-ret
agnd	8	7	vcc
agnd	10	9	vcc
agnd	12	11	agnd_sense
com1b	14	13	vcc_sense
clk1b	16	15	com1
dgnd_sense	18	17	clk1
dgnd	20	19	dgnd
vdd	22	21	vdd
dgnd	24	23	dgnd
vdd_sense	26	25	reset/temp2
select	28	27	com0
com0b	30	29	clk0
clk0b	32	31	led
ledb	34	33	ledx
ledxb	36	35	temp1

fig 3

New Pins

During the February 2000 SCT week, Ned Spencer suggested that the present scheme, in which the sense lines (VCC_SENSE,VDD-SENSE, AGND_SENSE and DGND_SENSE) are connected to the appropriate power line on the Opto-Flex close to the module connector was less than optimal in that the sensing did not include the connector resistance and the hybrid power track resistance, and therefore introduced an error into the voltage setting. If sensing was done on the hybrid the error in voltage setting due to the power track resistance would be halved (at best) since the sensing can only be done at one point, and that due to the connector (small, with multiple pins?) eliminated.
I do not believe that the benefits of the halving of the uncertainty of the voltage due to the power track resistance is significant, especially as this resistance is fairly constant and the global currents are known. On the other hand what about the resistance of the connector? The SAMTEC specification for the connectors used is 10 mOhms max. The connectors are used at less than half the max current quoted by SAMTEC and will be operated well within the specified temperature range. With the existing pinout The maximum go-and-return voltage drop due to the connectors would be 8 mV for VCC and 5 mV for VDD. The SCT_LV specification gives a setting / monitoring RESOLUTION of 10 mV. The total uncertainties given the existing pinout represents approximately 1% of VCC and of VDD. Nonetheless there are always worries always about the degree to which connector specifications are understood. taking the sense lines onto the hybrid would eliminate those worries. Are there disadvantages apart from the extra pins? My main worry is reliability. We would be introducing 4 single-line potential failures. It may be that a module with a failure in a sense line could be successfully powered but I wouldn't like to rely on that. It is also true that the sense lines in the remainder of the system (i.e. low mass thin tape, PP1, low-mass thick tape, PP2, thin conventional cable, PP3, conventional cable to SCT_LV) are not duplicated, but that fact gives me little comfort.

Temperature monitoring.

The current proposal is to use Thermistors. These have a higher temperature coefficient than Pt1Ks and a 2-wire readout can be used. The most straight-forward technique is to have the thermistors connected to DGND at the hybrid and to use 2 wires, temp1 and either temp2 or RESET as shown in fig 4, for the case where the sense lines are not taken to the hybrid. A return reference is required and DGND_sense can be used for this. However hybrid designers should note that the thermistors ought not be connected to DGND locally but close to the connector, as indicated by the sketch. In this case the error due to the voltage drop across the connector should be less than 2 mV

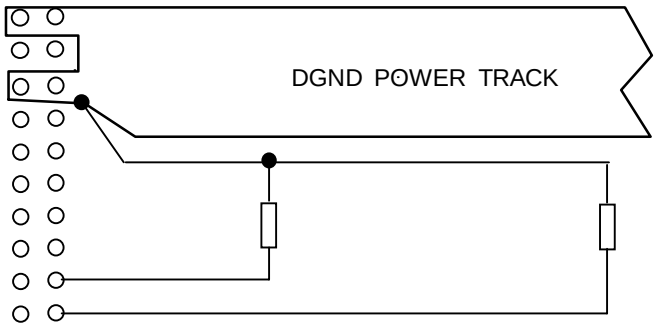

fig 4

(there are 4 DGND pins, each less than 10 mOhms). For the proposed thermistors this corresponds to a fraction of 1 degree. Note that the sketch is purely symbolic in that it only indicates the principle, the actual pinout is not indicated.
fig 5 shows the layout which should be used in the case where DGND_sense is brought onto the hybrid.

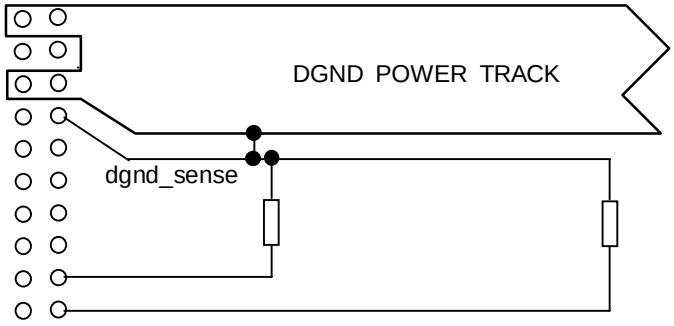

fig 5

Change of Pin Assignment

It might have been imagined that hybrid designers would have requested, in the light of experience, a change of pinout to produced a more logical layout. However no such change appears to have been requested. The only requested change, apart from the addition of the 4 sense lines, is the proposal from Oxford. In fig 3 this proposal is shown. The 4 new signals are shown in red. Unchanged signals are shown in black, and in green are shown those signals which have been moved by just one pin position. No existing signal has been moved by more than one pin position. It is clear that, apart from the additional 4 lines, the changes are quite small from the point of view of hybrid layout, most lines remain the same, and the remaining signals change position by only one pin.

Gender Change

It has been requested (by UCL ?) that the socket should be on the Opto-Flex and the plug on the module. This, as I understand it has been for 2 reasons. One, that the bias voltage would be safer on a socket with the module disconnected. Given that both connectors are through hole types I'm not sure this is really true, however we should look into this as Opto-harnesses must be tested at maximum specified bias. Two, that a socket would be less prone to mechanical damage when the harness is inserted through the module brackets. This may be true, although I'd have hoped the harness installers would be adequately careful!
My feelings on this issue are that if a change in connector size or pinout was proposed such that it would be incompatible with existing modules then the gender should be changed. At least it would be a clear indicator of module type. However I don't believe that the arguments for gender changing are strong enough to stand on their own.

Summary

The most difficult decision is whether to add the 4 sense lines. There are pros and cons, if the decision is made to add these lines then compatibility is lost between existing modules (-1) and the new modules (0). The Oxford proposal seems sensible, requires minimal changes to the hybrid. The proposal assumes that the temp2/reset scheme will be adopted. If the Oxford proposal is adopted then it would seem reasonable to change the gender of the connectors.
If it is decided that the 4 sense lines need not be taken to the hybrid, then do we need the other changes in the Oxford proposal.? Referring to fig 2, there are 4 unused pins. We could simply remove the pins, and accept the tiny unnecessary mass of the additional plastic. Now we would retain compatibility between Module -1 and Module 0.
I would like to offer a compromise. If temp1 is moved to pin 13, then pins 35 and 36 are unused, and a 34-pin connector can be used as in fig 6. This means a change on the hybrid, but a change is needed anyway to improve the connections to the temperature sensors as detailed in figs 4 and 5. Now Module -1 is compatible with Module 0 in all respects but 1: a Module -1 connected to a dogleg 0 would not have its temp sensor 1 connected and the same is true of a Module 0 connected to a dogleg -1. I believe that it would be ok to run modules on the system test with only one temperature sensor connected if that was necessary. This pinout also assumes that the temp2/reset scheme will be adopted. If this scheme is not adopted the we have to address the pinout question again. With this pinout the gender of the connectors remains the same. I believe that either scheme would be satisfactory for Atlas, and that the choice is almost a matter of personal taste. I worry about incompatibility of doglegs and modules during the next year, so my vote is for the fig 6 scheme.

bias	2	1	bias
bias_ret	6	5	bias_ret
agnd	8	7	
agnd	10	9	vcc
agnd	12	11	vcc
	14	13	temp1
com1b	16	15	com1
clk1b	18	17	clk1
dgnd	20	19	dgnd
vdd	22	21	vdd
dgnd	24	23	dgnd
select	26	25	reset
com0b	28	27	com0
clk0b	30	29	clk0
ledb	32	31	led
ledxb	34	33	ledx

fig 6

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