An inexpensive microcomputer peripheral I/O expansion

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Using a one-chip programmable peripheral interface LSI (8255A), an inexpensive microcomputer (8K PET) peripheral I/O expansion can easily be constructed.

Recent developments in microcomputer interfacing techniques make real-time control of experiments relatively inexpensive (Parks, 1978). Peripheral I/O lines are under software control. Usually, these I/O device lines are controlled by 8-bit programmable I/O control register within a one-chip interfacing integrated circuit (IC) such as Intel's programmable peripheral interface (PPI) 8255A (24 programmable I/O lines), MOS Technology's peripheral adapter (PA) MCS6520 (16 programmable I/O lines), versatile interface adapter (VIA) MCS6522 (16 programmable I/O lines), and MCS6530 (16 programmable I/O lines with ROM/RAM and timer), or Motorola's peripheral interface adapter (PIA) MC6820, 6821, 68A21, 68B21 (16 programmable I/O lines), and MC6846 (8 programmable I/O lines with ROM and timer).

The PET (2001-8 type)¹ has BASIC-accessible 8-bit parallel I/O lines for laboratory interfacing: Half of the TTL-compatible lines (PA0 to PA7) of the MCS6522VIA remain free as the parallel user port and are directly BASIC accessible using "PEEKing" and "POKEing" at each I/O register address (Commodore Business Machines, Inc., 1978). These "built-in" 8-bit I/O lines of the PET have led to the experimental use of real-time laboratory interfaces for connecting switch inputs and outputs to power drivers (or relays) that are simple and inexpensive (McLean, 1978; Osaka, 1979a, 1979b). However, 8-bit I/O lines appear insufficient for the more complex parallel I/O processing, that is, laboratory interfaces for high-resolution (1,024- to 4,096-step) data acquisition system such as A/D and D/A converting and BCD counting. This insufficient I/O capability to communicate with the outside world has led to the expansion of the programmable I/O lines described here. PET's I/O expansion using "built-in" IEEE connector has been reported elsewhere (Lewin & Helm, 1979). In the system described here, the PET provides 24 (or more) expanded I/O lines via an 8255 PPI chip (Intel Corporation, 1979) with four additional NAND gates.

As Figure 1 shows, the logic interface simply consists of two inexpensive IC chips (8255 and 74LS00). These

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Figure 1. A simple I/O expansion using 8255A interfacing logic via PET's memory expansion port.

24 I/O lines are also BASIC accessible using "PEEKing" and "POKEing" at each I/O register address. Figure 2 indicates I/O selection code values and hexadecimal/decimal addresses for each I/O handling in the PET memory map. As previously noted, these expanded I/O lines can easily be used in various ways: Figure 3 provides an example BASIC program in which 16-bit (PA and PB ports) and 8-bit (PC port) lines are programmed to operate as input (BCD counter) and output (short-pulse output) lines, respectively. The total cost of the I/O expansion interface is less than \$10.

Input/Output Selection Code

Decimal value of N*	I/O port			
	PA	PB	Upper	Lower
128	Output	Output	Output	Output
129	Output	Output	Output	Input
130	Output	Input	Output	Output
131	Output	Input	Output	Input
136	Output	Output	Input	Output
137	Output	Output	Input	Input
138	Output	Input	Input	Output
139	Output	Input	Input	Input
144	Input	Output	Output	Output
145	Input	Output	Output	Input
146	Input	Input	Output	Output
147	Input	Input	Output	Input
152	Input	Output	Input	Output
153	Input	Output	Input	Input
154	Input	Input	Input	Output
155	Input	Input	Input	Input

* POKE 45063,N, where 45063 is decimal address of control word register (8-bit)

	Hexadecimal Address	Decimal Address
PA Port	B004	45060
PB Port	B005	45061
PC Port	B006	45062
Control Word Reg.	B007	45063

Figure 2. I/O selection code value (8255A:mode=0) and hexadecimal/decimal addresses for each I/O handling in the PET memory map.

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10 PRINT"clr":TIS="000000":A=45060:B=45061:C=45062:W=45063
20 INPUT"I/O PORT SELECT:N=":N:POKEW,N
25 REM BCD COUNTER:DATA READ FROM PA AND PB PORT
30 K=PEEK(A)AND15+(PEEK(A)AND240)/16*10
40 L=(PEEK(B)AND15)*100+(PEEK(B)AND240)/16*1000
50 PRINT"clr,home,dn,dn,dn":PRINT"DATA="K+L
55 REM 100 MS SEQUENTIAL PULSE OUT TO PC PORT
60 FORJ=0TO7:Z=2+J:POKEC,Z:GOSUB100:POKEC,0:PRINTZ:NEXT:GOTO30
70 STOP
100 V=TI
110 IFTI-V>6THEN130
120 GOTO110
130 RETURN

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Figure 3. An example BASIC program in which 16-bit (PA and PB) and 8-bit (PC) lines are programmed to operate as input (BCD counter) and output (100-msec pulse out) lines, respectively.

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NOTE

1. It should be noted that the system described here is restricted only to the PET 2001-8 (8K RAM type), which has a memory expansion connector.

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