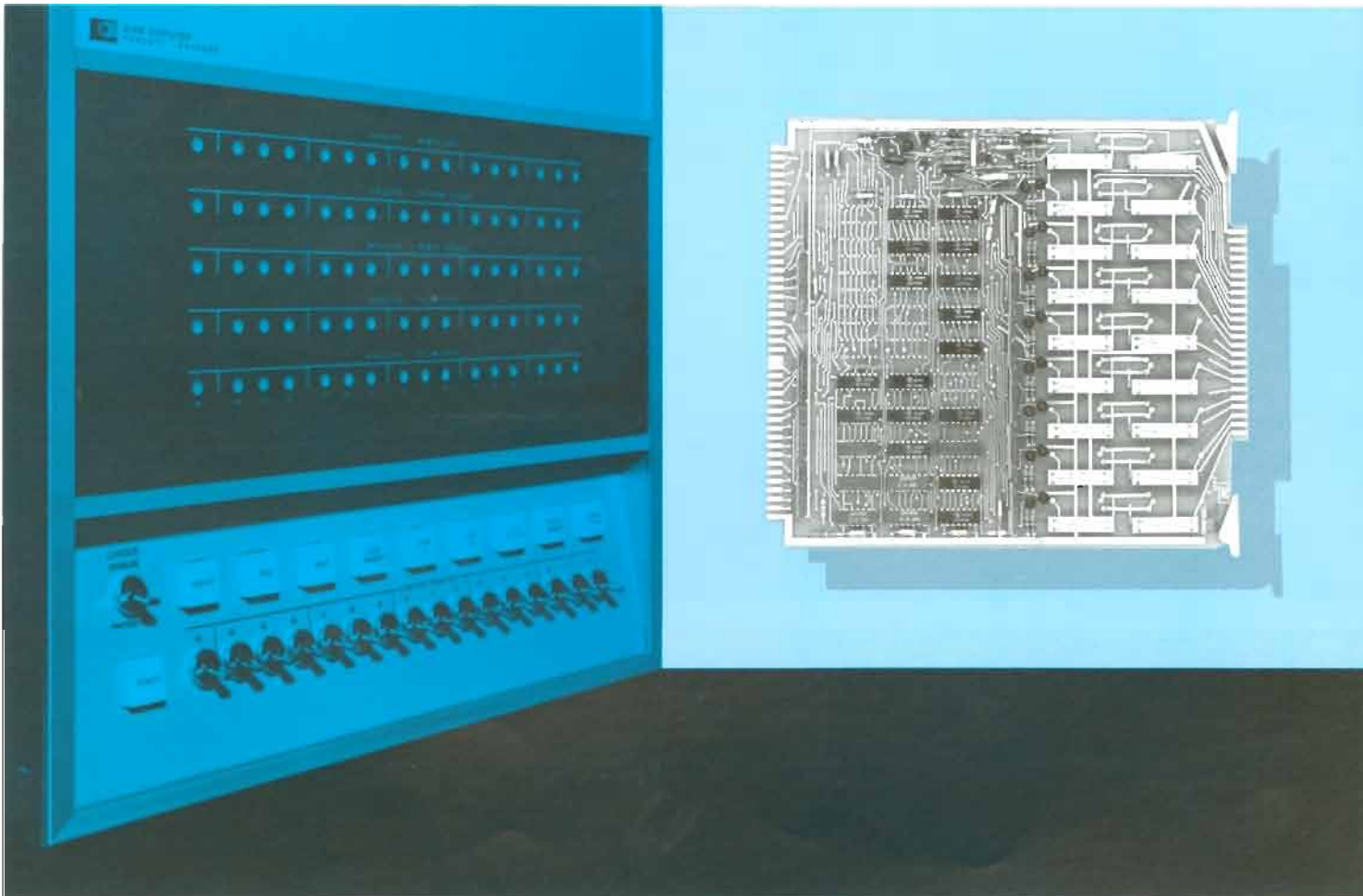




16-BIT RELAY OUTPUT REGISTER



FEATURES

16-BIT OUTPUT — Bit states may be used in combination or separately to control from 1 to 16 devices. Up to 65,536 (2^{16}) conditions of a single device can be programmed.

FLOATING CONTACT CLOSURES — Avoid ground loops between computer and controlled devices and permit flexible use of output bit states.

OPTIONAL READ-BACK CAPABILITY — Allows verification of output register contents.

POWER-ON INITIALIZATION — Predetermines initial states of all relays after computer power turn-on. Two groups of 8 relays each can be preset differently (one group of relays preset open and the other group all closed) or both groups (all 16 relays) can be preset open or closed, depending upon hard-wired jumper connections on the register board.

COMMAND-INTERRUPT LOGIC — Provides two-way communication between the computer and the device controlled by the Relay Register.

SIMPLE INSTALLATION — Plug the register into a computer I/O slot and complete installation by wiring its mating connector to the controlled equipment. Hardware and instructions are provided to assist you in making an interconnect cable to your external device.

PROGRAMMING

Programs to control the relays on the Relay Register will naturally be prepared according to each particular application. This will be easy because programming is simple; the following program and output subroutine is provided as an example. The Relay Register is assumed in the sample output subroutine to have a Select Code of 17g. The subroutine is used for non-interrupt operation and therefore provides a 1-millisecond delay between output instructions to allow for relay contact operating time.

MAIN PROGRAM

```
      .
      LDA   N           Where N is an integer value whose bits in the A-Register correspond
                        to the relay contacts to be closed on the Relay Register card.
      JSB   RELAY       Jump to Relay Register card subroutine.
      .
N     OCT   000007     Closes relay contacts corresponding to bits 2, 1, and 0.
```

RELAY OUTPUT REGISTER CARD OUTPUT SUBROUTINE

```
RELAY  NOP
      OTA   17B         Output the contents of the A-Register to the Relay Register card.
                        {Relays will be energized by "1" bits and de-energized by "0" bits
                        from the A-Register.}
      LDB   COUNT       Set counter in Computer to take up 1 millisecond to allow relay
      STB   CNTR        contacts to operate before acting upon the data entered in the
      ISZ   CNTR        register.
      JMP   *-1
      JMP   RELAY,I     Return to main program. The relay contacts have operated, con-
                        necting the output states to the external device.
COUNT DEC   -200      The COUNT depends upon the total execution time of ISZ and
CNTR   DEC   0         JMP instructions. In the 2116, for example, these total 5.2  $\mu$ s, so
                        200 repetitions are required to total 1 millisecond. In HP 2115
                        and 2114 Computers, these instructions take 6.5  $\mu$ s, so 155
                        repetitions would be required to total 1 millisecond.
```

ADDING A RELAY REGISTER TO YOUR HP COMPUTER

The Relay Register provides 16 floating contact closures which can be used for controlling one device, or be subdivided in any combination to control several devices. The voltages switched through the relay contacts can differ from each other, and from computer ground, by as much as 100V peak. Contacts can be connected in series, parallel, or in series-parallel, with or without diode isolation.

POWER ON PRESET

Turn-on of computer power automatically presets register flip-flops that store the output bit states for the various relays. The presets are applied separately to the register flip-flops for bits 15 through 8 and those for bits 7 through 0, as shown in Figure 1. Hard-wired jumper connections to each group of eight flip-flops determine whether all the flip-flops in a group will be set, closing the respective relay contacts, or cleared, allowing the relay contacts to open. Initialization assures that the states of all relays are known immediately after power turn-on, which is particularly desirable when power supplies are being programmed. This feature also saves initialization instructions that might otherwise be required in computer programs.

OUTPUT OPERATIONS

An Output instruction (OTA or OTB) transfers 16 data bits from the computer A- or B-Register to the storage register flip-flops, in turn energizing the corresponding relays through transistor driver circuits, closing the relay contacts.

The relays retain their states unless changed by the next OTA or OTB instruction. Relay contacts close or open within 1 millisecond following transfer of new bit states to the storage register on the card.

READ-BACK OPERATIONS (with Option 001)

The bit states applied to the relays can be read back into the computer A- or B-register by an Input instruction (LIA or LIB). The read-back capability also permits any part of a program to determine the state of the relays at any given time.

COMMAND-INTERRUPT CAPABILITY

In addition to the 16-bit relay output, the Relay Register is equipped with command and interrupt logic that makes possible a two-way exchange of control and status or request information between the computer and controlled equipment. Typically, the computer will use the command logic to 'tell' a controlled equipment that new data has been entered in the Relay Register. The controlled equipment will normally use the interrupt logic to 'ask' the computer for the next data word to be transferred via the Relay Register.

The command output is generated in response to a Set Control (STC) instruction in the program. This instruction sets the Control and Command flip-flops (Figure 1), enabling the interrupt request logic in addition to activating the command output. There is a choice of two command outputs, which can be used individually or simultaneously. One of the outputs comes from a ground-referenced driver transistor and the other is an isolated (floating) contact closure that can be used as flexibly as any of the 16 sets of relay contacts that make up the output data.

An interrupt request is generated in response to a flag signal from the controlled equipment. This signal sets the Response flip-flop, which clears the Command flip-flop and activates the interrupt request logic when it has been enabled by the set output of the Control flip-flop. As shown in Figure 1, the Relay Register provides an isolated flag input to a relay coil as well as a ground-referenced input to a driver transistor. (The +12V input to the relay coil need not be referenced to computer ground.) Energizing the relay coil grounds the input line to the driver transistor, which sets the Response and Flag flip-flops. Where the isolation provided by the relay coil input is not needed, an external circuit closure to ground has the same effect.

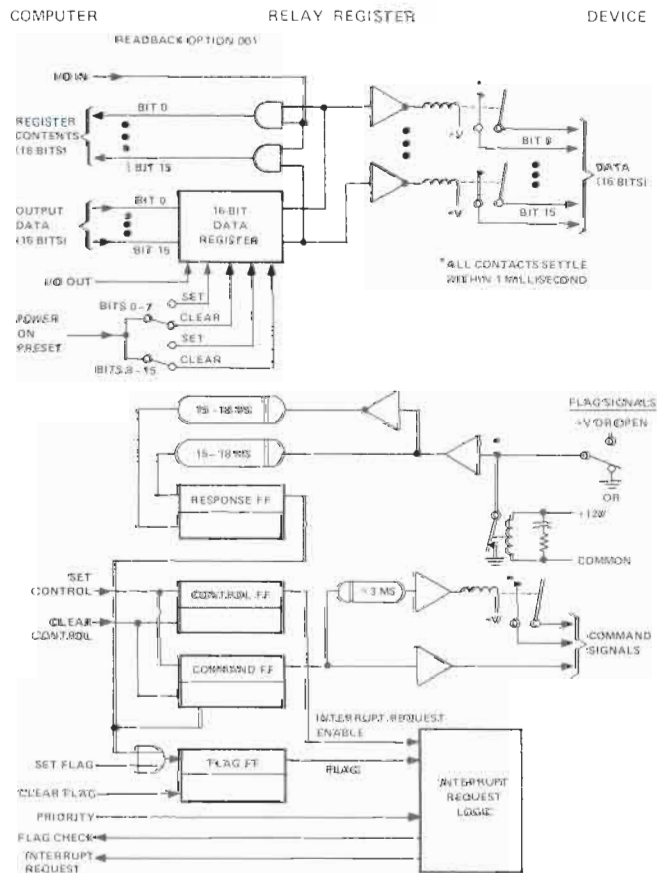
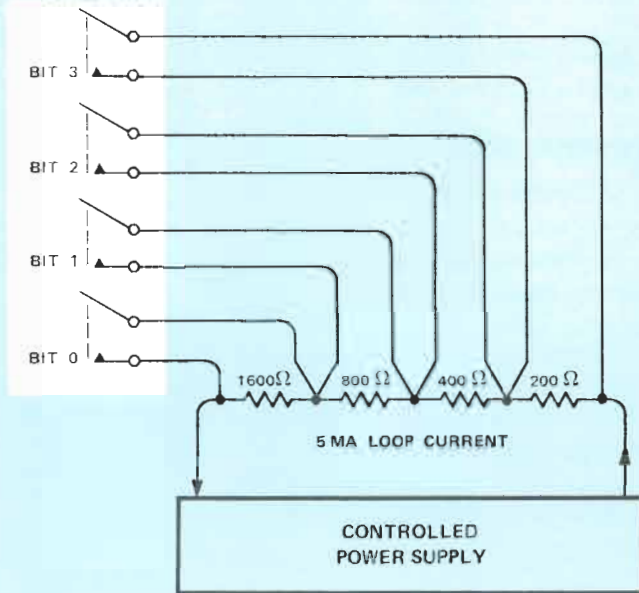


Figure 1

A TYPICAL APPLICATION - POWER SUPPLY CONTROL

RELAY OUTPUT CARD



| RELAY STATES | | | | LOOP RES. (OHMS) | OUTPUT |
|--------------|-------|-------|-------|------------------|--------|
| BIT 3 | BIT 2 | BIT 1 | BIT 0 | | |
| C | C | C | C | 0 | 0V |
| | C | C | C | 200 | 1V |
| C | | C | C | 400 | 2V |
| | | C | C | 600 | 3V |
| C | C | | C | 800 | 4V |
| | C | | C | 1000 | 5V |
| C | | | C | 1200 | 6V |
| | | | C | 1400 | 7V |
| C | C | C | | 1600 | 8V |
| | C | C | | 1800 | 9V |
| C | | C | | 2000 | 10V |
| | | C | | 2200 | 11V |
| C | C | | | 2400 | 12V |
| | C | | | 2600 | 13V |
| C | | | | 2800 | 14V |
| | | | | 3000 | 15V |

A four-bit set of relay output states can program 16 (2^4) different power supply voltages, as shown above.

The 16-bit output from the Relay Output Register can program 16 different voltages from four different power supplies, 256 (2^8) different voltages from two power supplies, or up to 65,536 (2^{16}) different voltages from a single power supply.

SPECIFICATIONS

RELAY CONTACTS

States: All contacts are normally open when power is off; contacts close individually in response to '1' bit states from computer.

Maximum Power: 10W peak or continuous, per contact.

Maximum Voltage: 100V peak or continuous across open contacts, between output connector pins, and with respect to computer ground on the register card.

Maximum Current: 500 mA per contact, peak or continuous.

Life: 10 million operations under rated load.

Resistance: 0.1Ω at 100 mA (higher at lower current).

Protection: Mounting positions are provided for connecting contact protection resistors in series with the contacts of all the relays.

Settling Time: 1 millisecond, maximum, for pull-in or drop-out.

DATA OUTPUT

(16 floating relay contacts, with ratings as specified above)

'1' Level: Contact closed.

'0' Level: Contact open.

Power-on Preset: Register is normally wired to preset all data relays open. Upon request at time of ordering, register will be wired to preset bits 15 through 8 or bits 7 through 0 open, or all bits closed when power is turned on.

COMMAND OUTPUT, GROUND-REFERENCED

'1' Level: 0V, 12 mA current sink.

'0' Level: +12V through $10k\Omega$.

COMMAND OUTPUT, ISOLATED

(Floating relay contact, with ratings as specified above)

'1' Level: Contact closed.

'0' Level: Contact open.

Delay: 3 milliseconds nominal.

RESPONSE (FLAG) INPUT, ISOLATED

Normal: 12V, 15 mA to relay coil.

Set Flag: No input to relay coil.

Response Delay: 15 milliseconds, nominal.

RESPONSE (FLAG) INPUT, GROUND-REFERENCED

Normal: 0V, 12 mA current sink from NPN transistor.

Set Flag: Open Circuit.

Response Delay: 15 milliseconds, nominal.

INTERFACE CURRENT SUPPLIED BY THE COMPUTER

Interface Kit 12551B:

0.24A (+12V), 0.39A (-2V), 0.6A (+4.5V)

Interface Kit 12551B-001:

0.24A (+12V), 0.59A (-2V), 1.1A (+4.5V)

WEIGHT Net: 17 oz. (482 g) Shipping: 4 lb. (1,82 kg)

EQUIPMENT FURNISHED

(Order by Interface Kit Number)

Interface Kit 12551B-001, consisting of:

1. Relay Output Register (without read-back option), Part No. 12551-6001.
2. Connector Kit, 48 pin, Part No. 02116-6178.

Interface Kit 12551B-001, consisting of:

1. Relay Output Register (with read-back option), Part No. 12551-6002.
2. Connector Kit, 48 pin, Part No. 02116-6178.