THE QUALITY ASSURANCE TESTS OF THE CLC426 OP AMP DICE FOR THE PHENIX MULTIPLICITY VERTEX DETECTOR

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1. Introduction

The op amps incorporated in the PHENIX Multiplicity Vertex Detector (MVD) convert the output current pulses from the discriminators into voltage signals as part of the PHENIX first level trigger input signals. The Comlinear CLC426 combines an enhanced voltage-feedback architecture with an advanced complementary bipolar process to provide a high-speed op amp with very low noise (1.6nV/$\sqrt{Hz}$ 2.0pA/$\sqrt{Hz}$) and distortion (-62/-68dBc $2^{nd}/3^{rd}$ harmonics at $1V_{pp}$ and 110MHz), and to provide a wide 230MHz gain-bandwidth, a fast 400V/μs slew rate, and very quick 16ns settling time to 0.05%. To assure the quality of the op amps, we tested 293 op amps with a probe station. We mainly wanted to determine the op amp output signal's rise and fall times, the amplification, the offset, and the DC currents from the op amps.

2. The Test Setup

The test circuit is shown in Fig. 1. +5V and -5V DC were applied on pin 16 and pin 9 respectively. Two 68000pF are used as by-pass capacitors. Each DC voltage source was connected to an ammeter to determine the DC currents about 11mA $\sim$ 12mA.

The 476Ω resistor connected to pin 6 and the 4.68$K\Omega$ resistor between pin 6 and pin 14 determined the amplification of the op amp. For the chosen resistors of Fig. 1, the amplification should be given by

$$Amplification = 4.68K\Omega/476\Omega = 9.84. \tag{1}$$

The input square pulse was provided by HP 8082A Pulse Generator. The input pulse amplitude was 150mV, period was about 840ns, and the rise and fall times are about 3ns.

The op amp output signal was measured with a scope (Tektronix Digitizing Signal Analyzer 602A). The scope determined the rise and fall times, the amplitude, the period, and the offset of the op amp output signal.

In setting up the test circuit, we realized that the following two factors were keen to the quality of the output signal and proper DC currents: (1) compactness of the circuit; (2) proper shielding and grounding. A nicely setup circuit should be as compact as possible, and be shielded and grounded properly. In the real MCM assembly, the whole circuit will be much more compact than the test setup. The op amps that have passed our test should not be a problem after being incorporated in MCMs.

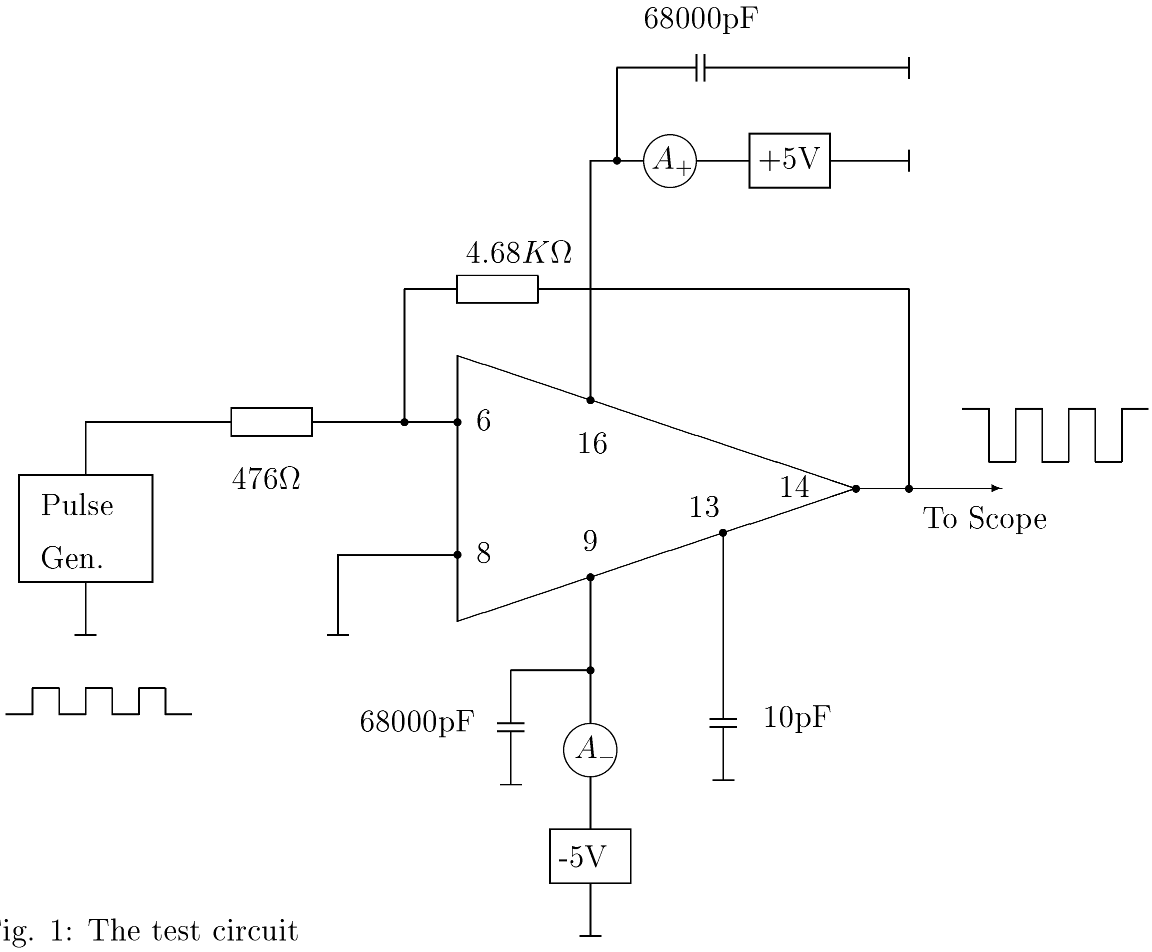

Fig. 1: The test circuit

3. The Test Results

A good op amp should have the following properties:

1. rise and fall times should be short, specifically rise(fall)/period should not be higher than 2.5%;
2. its amplification is close to the value in Eq. 1;
3. the offset of its output signal should be close to zero;
4. the DC currents measured in A_+ and A_- of Fig. 1 should not be higher than its maximum DC currents, which are about 11mA $\sim$ 12mA;
5. the mechanical damage due to the probes should be minimum in order to have good connections in MCM assembly.

We measured the properties 1, 2, 3 with a scope, and property 4 through two ammeter (i.e. A_+ and A_- of Fig. 1). For property 5, We mainly rely on visual inspection.

The details of the test results are located in MVD Silicon Detector Logbook 3 (p74-p93). Some of the test results are shown in the following table.

Op Amps	I_+(mA)	I_-(mA)	Amplit.(mV)	Rise T.(ns)	Fall T.(ns)
1	11.17	11.315	0∼-1400	16	19
2	11.39	11.530	0∼-1400	14	20
3	11.36	11.501	0∼-1400	15	19
4	11.36	11.505	0∼-1400	15	20
5	11.41	11.560	0∼-1400	15	19
6	11.32	11.461	0∼-1400	15	19
7	11.58	11.723	0∼-1400	15	19
8	11.31	11.458	0∼-1400	15	19
9	11.34	11.489	0∼-1400	15	20
10	11.58	11.724	0∼-1400	15	20
11	11.32	11.466	0∼-1400	15	20
12	11.36	11.506	0∼-1400	15	20
13	11.51	11.654	0∼-1400	15	19
14	11.43	11.570	0∼-1400	15	20
15	11.59	11.732	0∼-1400	15	21
16	11.22	11.362	0∼-1400	15	21
17	11.41	11.615	0∼-1400	15	20
18	11.39	11.537	0∼-1400	15	21
19	12.44	12.578	0∼-1400	12	35
20	11.38	11.516	-700∼-2100	10	20

From the table, we know that

1. the rise and fall times are around 20ns, which give rise(fall)/period $\leq 2.5\%$ and are quite satisfactory;
2. the amplification is $1400/150 = 9.3$, which is close to the expected amplification given in Eq. 1;
3. the offsets are zero except op amp 20, which had -700mV offset and would be thrown away;
4. the DC currents are around 11mA∼12mA, which are quite satisfactory;
5. op amp 19 was thrown away due to mechanical damage by the probes.

In conclusion, 293 op amps were tested by the above method and 245 op amps satisfied our QA specification. Those 245 op amps will be used in the MCMs.