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STOLZ, J. F.   Light Water Reactors Branch 1

SUBJECT: Supplements 790226 submittal on primary overcurrent fault protective sys. Matl pertains to ability of protective systems to prevent heat rises as related to containment structure.

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September 5, 1979

REGULATORY DOCKET FILE COPY

Mr. John F. Stolz, Chief
Light Water Reactors Branch No. 1
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Docket No. 50-275-OL
Docket No. 50-323-OL
Diablo Canyon Units 1 and 2

Dear Mr. Stolz:

In response to questions from the Staff, the attached material expands our February 26, 1979 submittal on Primary Overcurrent Fault Protective Systems for Containment Penetrations to include a discussion of the ability of the protective systems to prevent heat rises in the containment electrical penetrations from compromising the integrity of the containment structure.

Five copies of this submittal have been sent directly to Mr. Bart Buckley.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

Very truly yours,

Philip A. Crane, Jr.

B001
SE
1/40

Attachments

7909110533
A

PRIMARY OVERCURRENT FAULT PROTECTIVE SYSTEMS
FOR
CONTAINMENT PENETRATIONS

Additional Information

The attached Primary Protection Curves, have been revised from the February 26, 1979 submittal to include penetration conductor time-current curves for an initial conductor temperature T_1 of at least 132°C (270°F) and a final conductor temperature T_2 of 171°C (340°F). The initial temperature T_1 is assumed to be at least equal to the LOCA peak containment temperature shown in Figure 6.2-6 of the FSAR. Where required, because of continuous operation of equipment, the initial penetration conductor temperature T_1 was increased to give a conservative allowance for normal current heat rise in the penetration conductors. The final temperature T_2 is the penetration qualification test temperature of 171°C (340°F) (See Reference 1).

One curve, Figure 6, has been redrawn to reflect the new settings of the primary protective circuit breaker.

The equation (See Reference 2) to calculate the conductor time-current curve is

$$t = \frac{0.0279\ A^2}{I^2} \log \frac{T_2 + 234}{T_1 + 234}$$

where

t = Time-seconds

I = Current-amperes

A = Conductor area - circular mils

T_1 = Assumed initial conductor temperature (See above for details)

T_2 = Maximum allowable conductor temperature (171°C)

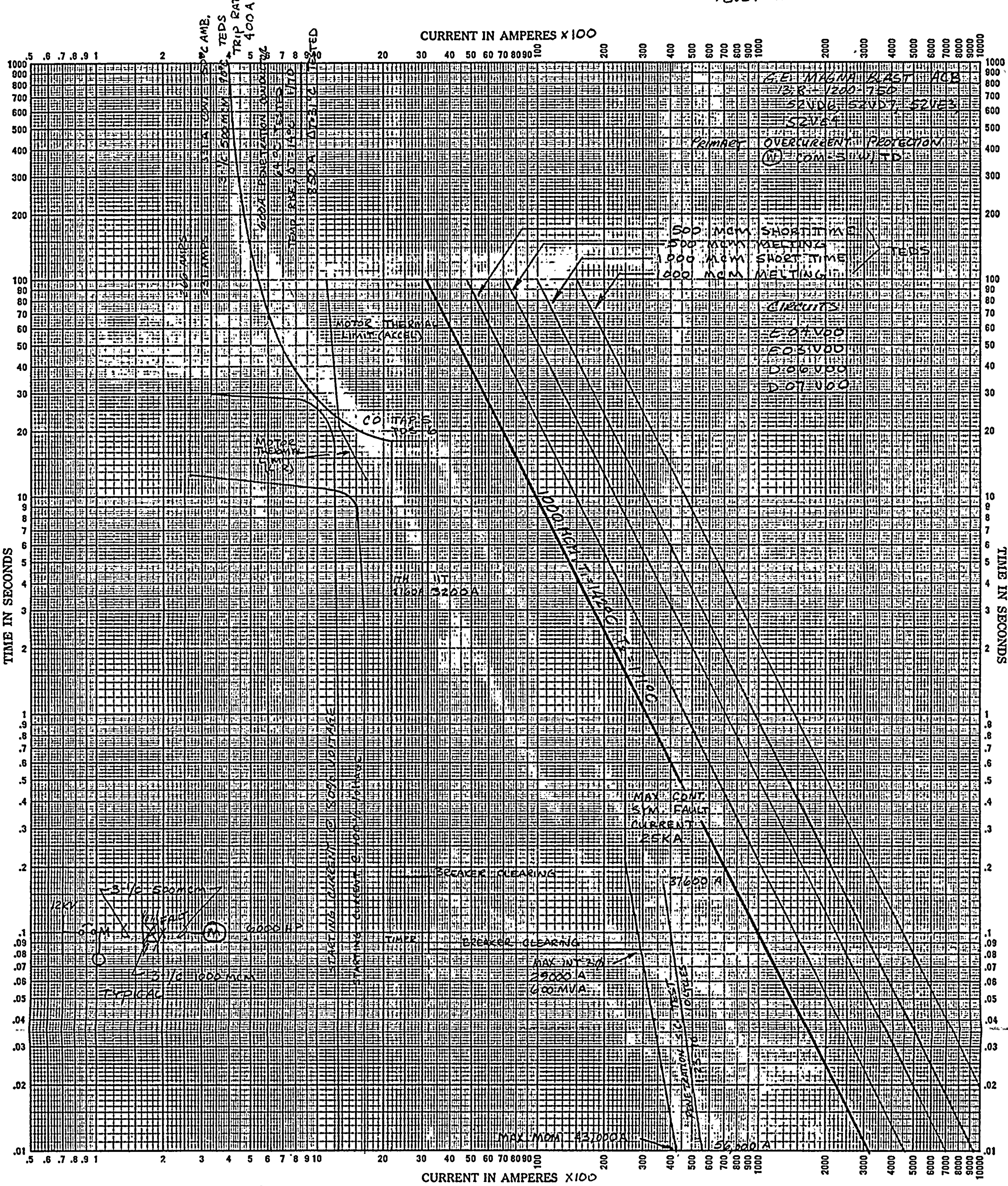
The calculations are based upon the assumption that all heat generated by the current flowing through the conductor remains in the conductor. This approach is conservative since conductors outside the containment will act as a heat sink and will cool the penetration conductors. The assumption that the penetration conductors reach the peak LOCA temperature as an initial condition is also conservative since the containment liner and concrete temperatures remain well below the peak and are therefore, unable to cause the conductors to reach the assumed T_1.

An evaluation of the Primary Protection Curves shows that all electrical penetrations at Diablo Canyon are adequately protected since overcurrents and short circuit currents will not cause undue heat rises in the penetration conductors during the worst postulated ambient conditions and therefore will not compromise the integrity of the containment structure.

Reference 1. General Electric 100 Series Electrical Penetrations Qualification Test Report dated January 18, 1974.

Reference 2. Short Circuit Characteristics of Insulated Cable, Publication P-32-382, Revised March 1969, Reprinted 1973, Insulated Power Cable Engineers Association (IPCEA)

PENETRATIONS 40E, 41E, 43E, 44E



REACTOR COOLANT PP'S TIME-CURRENT CHARACTERISTIC CURVES *PRIMARY PROTECTION*

For.. Fuse Links. In..

BASIS FOR DATA Standards .... Dated..................................

1. Tests made at.................. Volts a-c at.................. p-f., Starting at 25C with no initial load..................
2. Curves are plotted to.................. Test points so variations should be..................

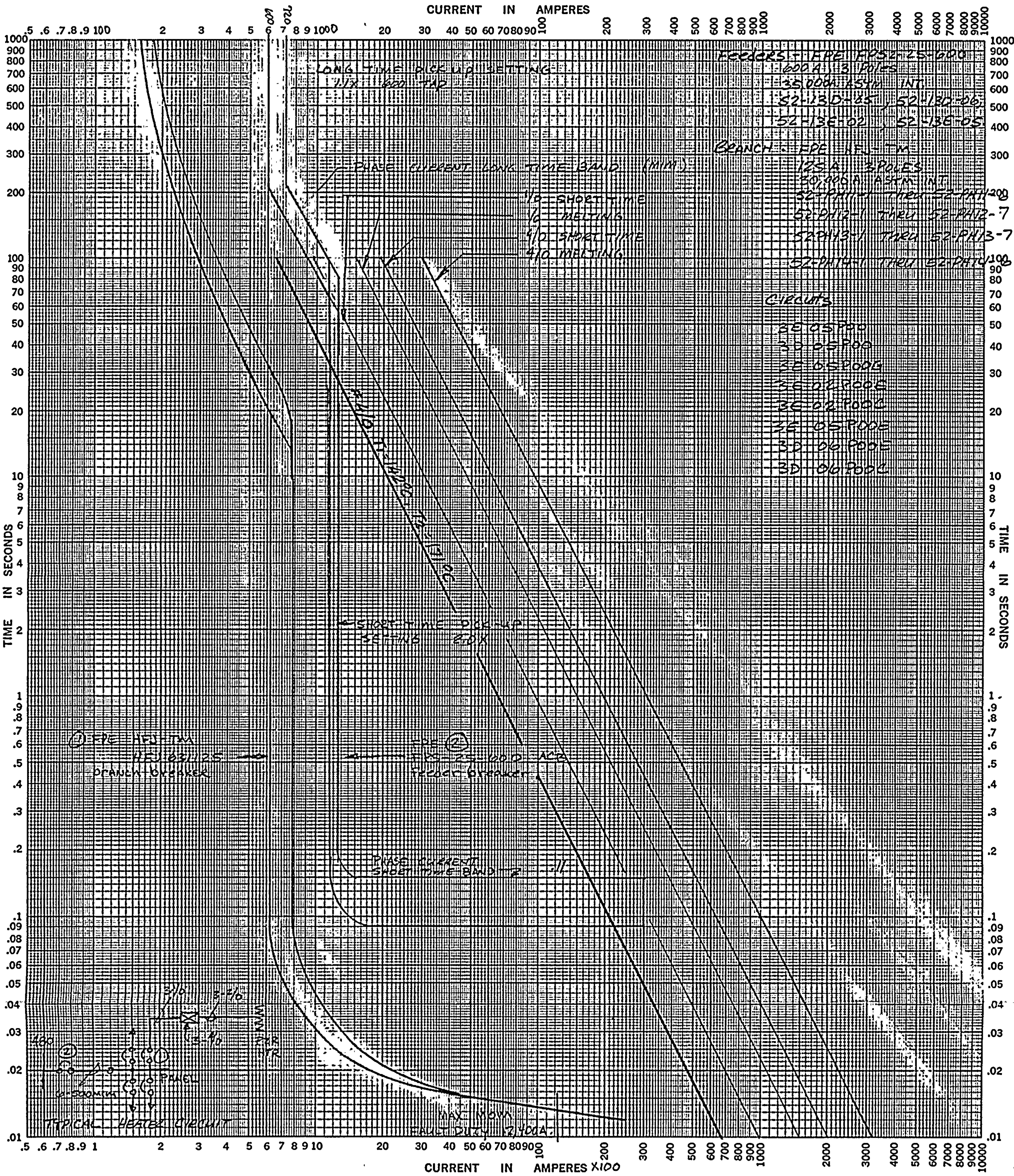
No..................

Date DEC. 1, 1978

Schematic - 437586-10
(W)

FIG. 1
REV. 8/17/79

PENETRATIONS
1E, 34E, 37E



PRESSURIZER HEATERS TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For_____ Fuse Links. In_____

BASIS FOR DATA Standards_____ Dated_____

1. Tests made at_____ Volts a-c at_____ p-f., starting at 25C with no initial load_____
2. Curves are plotted to_____ Test points so variations should be_____

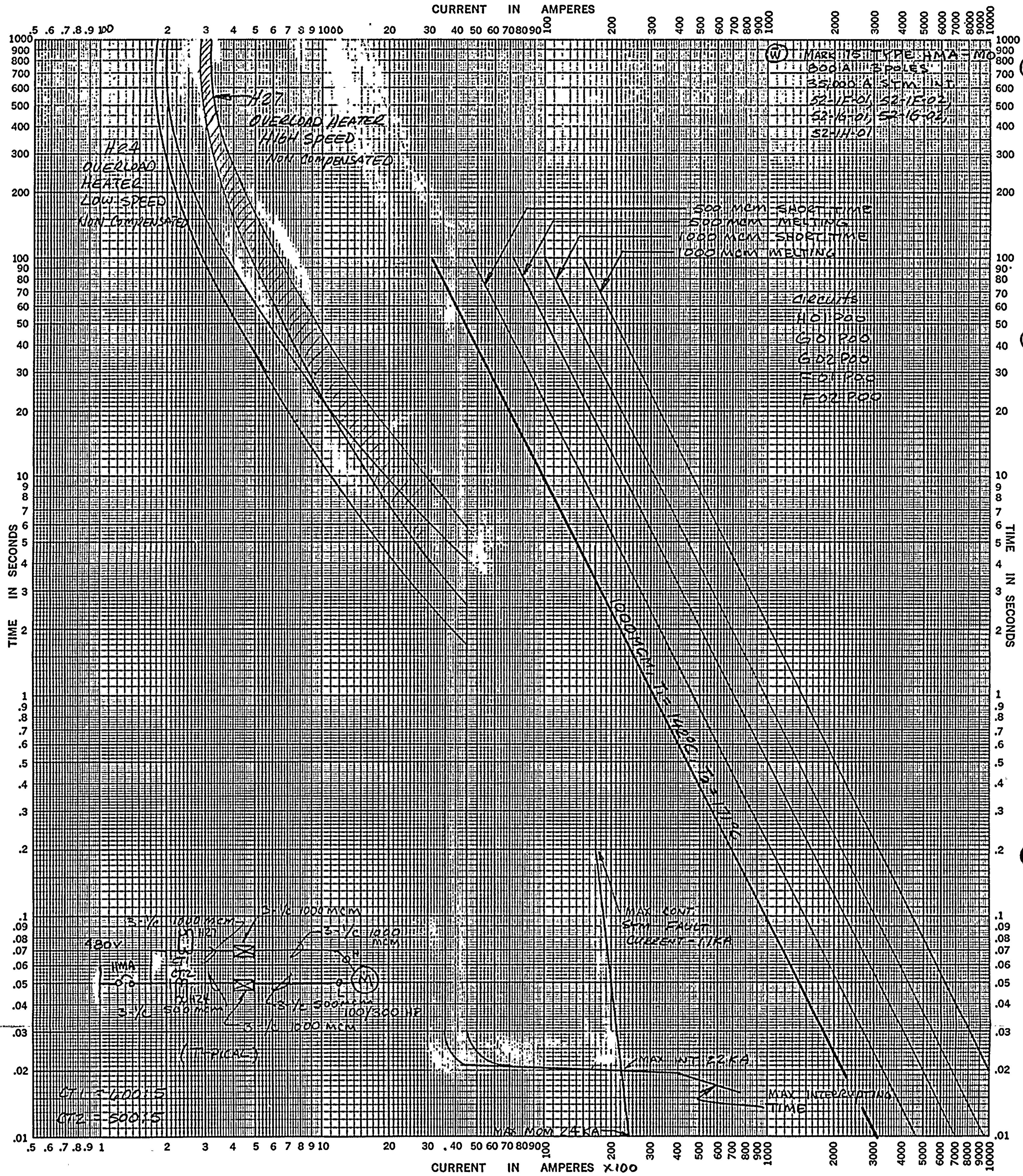
No._____

Date 12-14-78

K&E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 2
REV. 8/17/79

PENETRATIONS
3E, 9E, 15E, 29E, 32E

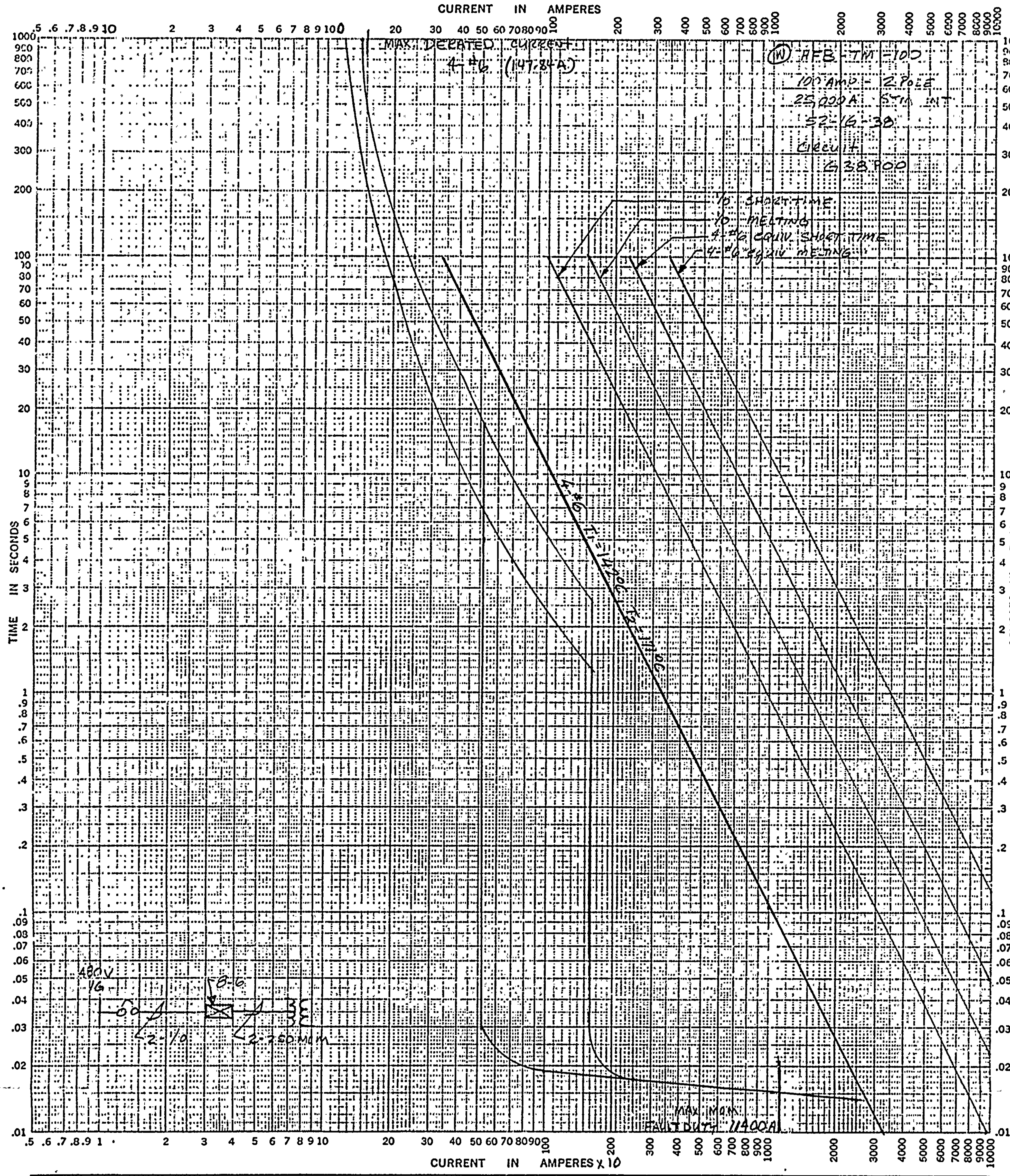


CONT. FAN COOLERS TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION	
For ______ Fuse Links. In ______	
BASIS FOR DATA Standards ______ Dated ______	
1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______	No. ______
2. Curves are plotted to ______ Test points so variations should be ______	Date 12-1-78

Schematic 437600-10

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 3
REV. 8/17/79 [illegible]



EMER. LTG. TLE 16 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For ______ Fuse Links. In ______

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______
2. Curves are plotted to ______ Test points so variations should be ______

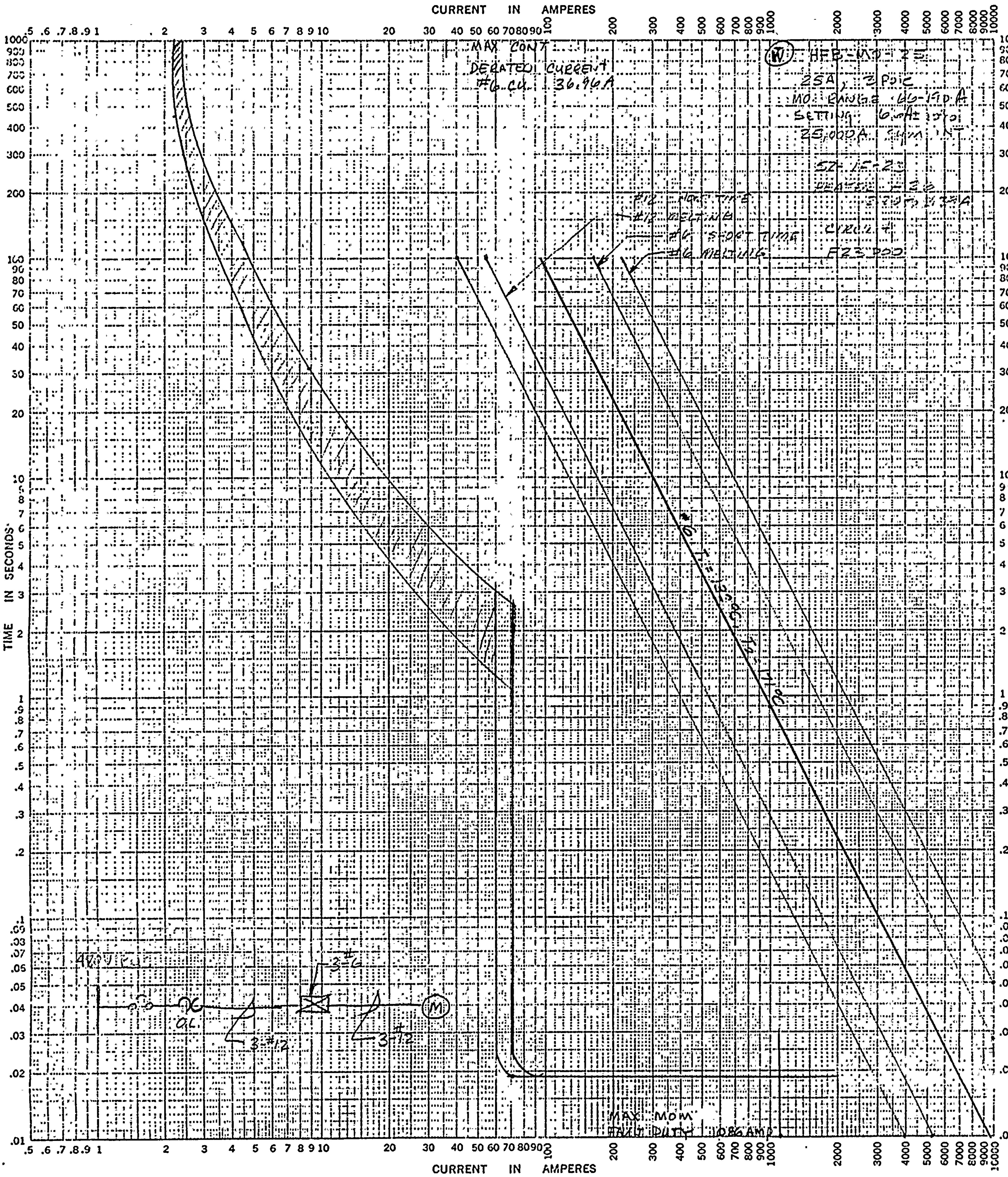
No. ______

Date JAN. 16, 1979

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 4
REV. 8/17/79

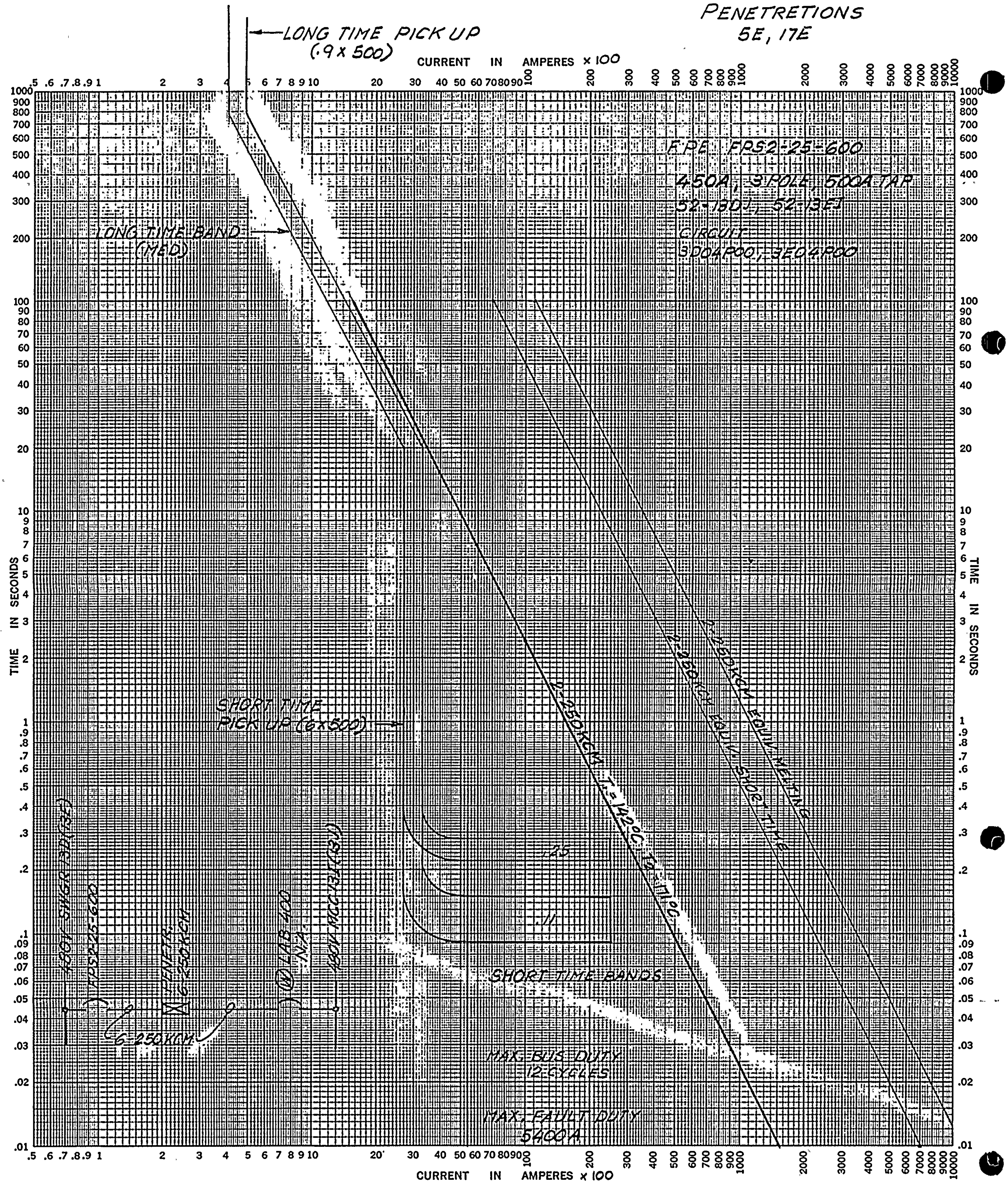
PENETRATION
26E



FCV 750 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION	
For________ Fuse Links. In________	
BASIS FOR DATA Standards________ Dated________	
1. Tests made at________Volts a-c at________p-f., starting at 25C with no initial load________	No.________
2. Curves are plotted to________Test points so variations should be________	Date JAN. 16, 1970

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 5
REV



DIABLO CANYON UNIT 1, MCC 13 BUS J & I TIME-CURRENT CHARACTERISTIC CURVES

For ________ Fuse Links. In ________

BASIS FOR DATA Standards ________ Dated ________

1. Tests made at ________ Volts a-c at ________ p-f., starting at 25C with no initial load ________
2. Curves are plotted to ________ Test points so variations should be ________

No. ________

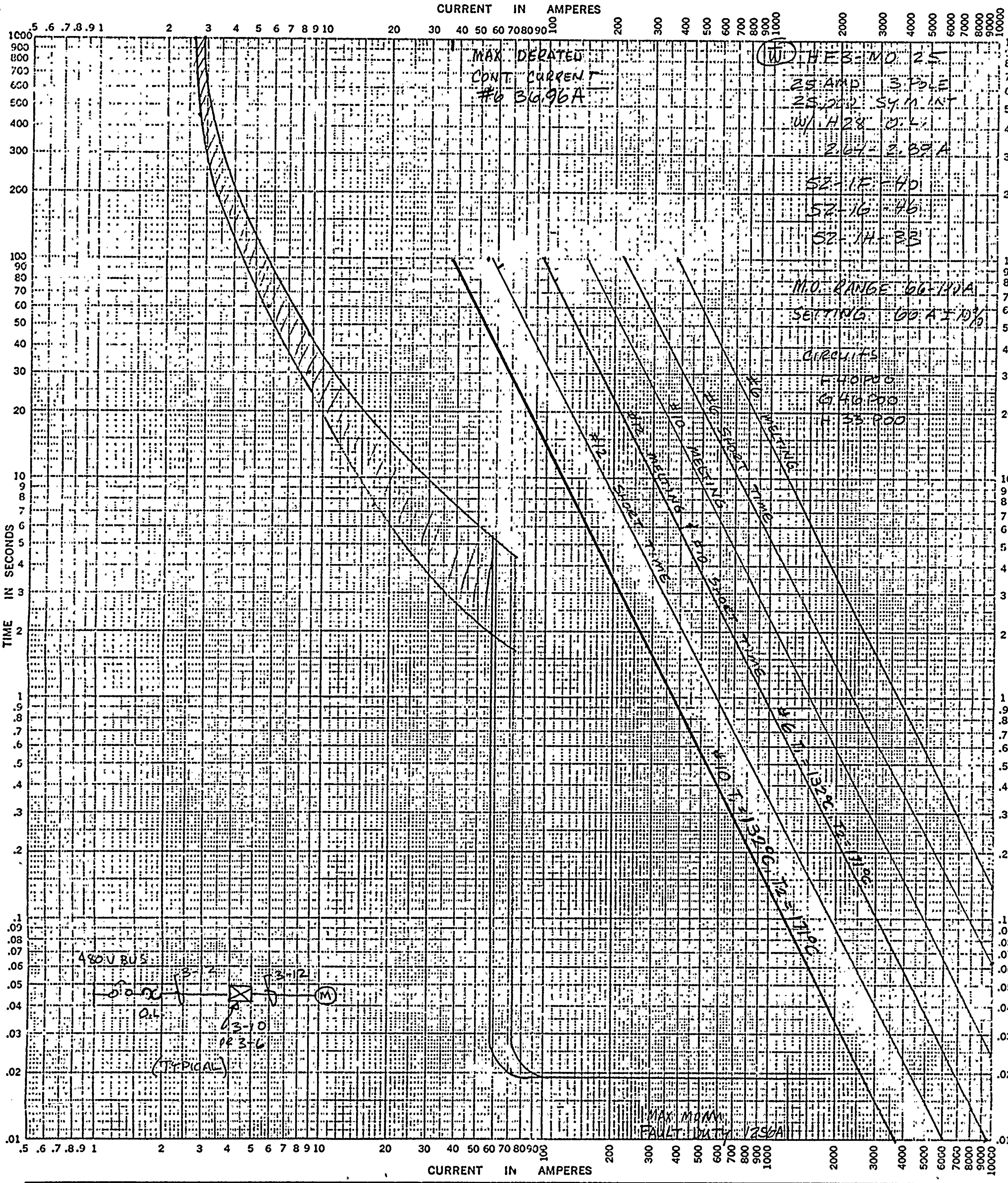
Date AUG. 7, 1979 J.E. Fields Jr.

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG. 6

REDRAWN 8/7/79

PENETRATION
26E, 19E, 12E



FEES PWR REL VV TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For ______ Fuse Links. In ______

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______

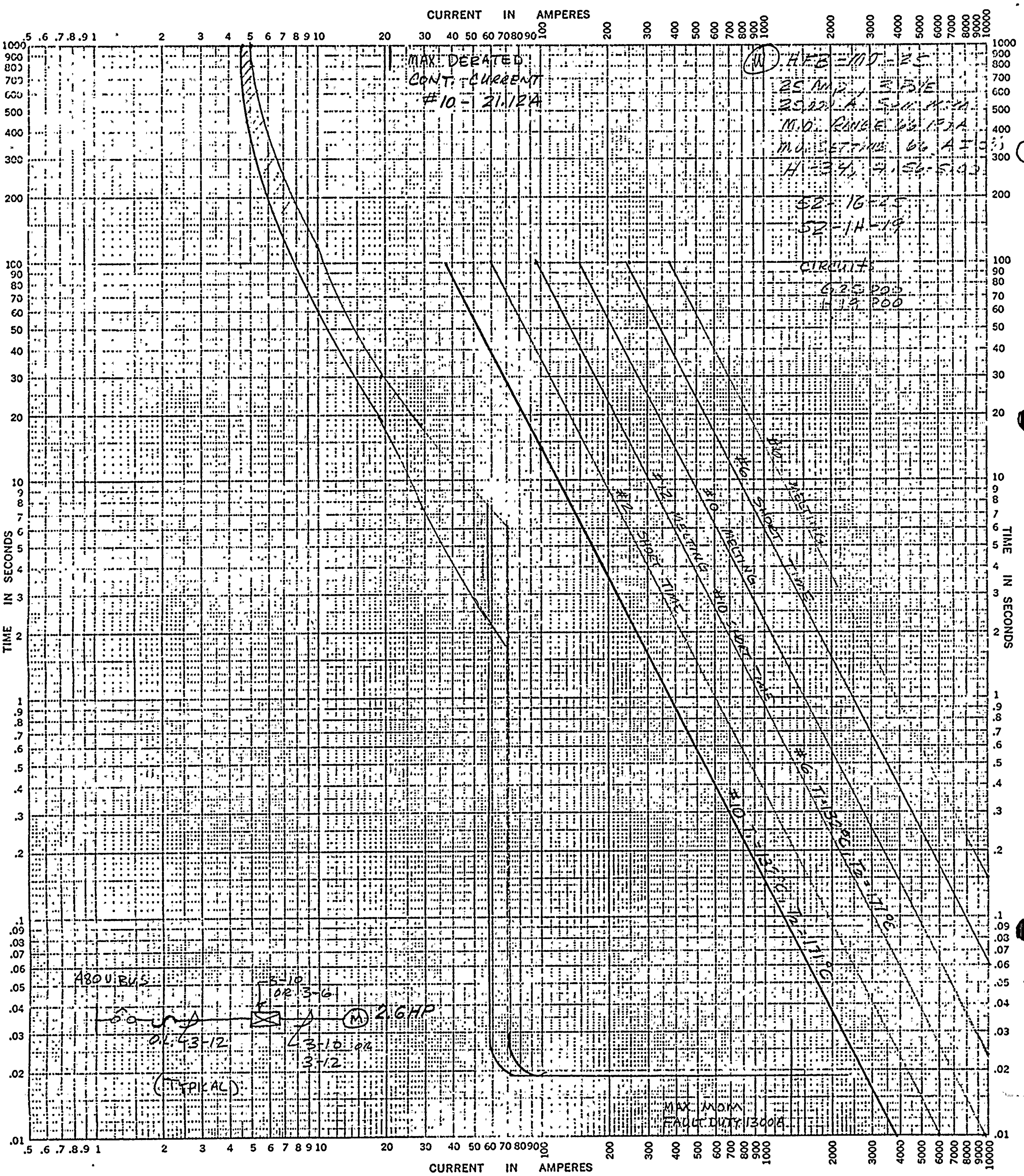
2. Curves are plotted to ______ Test points so variations should be ______

No. ______

Date JAN. 17, 1979

FIG 7
REV. 8/17/79

PENETRATION
19E, 12E



RHR SUCT. VALVE TIME-CURRENT CHARACTERISTIC CURVES Primary Protection

For ______ Fuse Links. In ______

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______

2. Curves are plotted to ______ Test points so variations should be ______

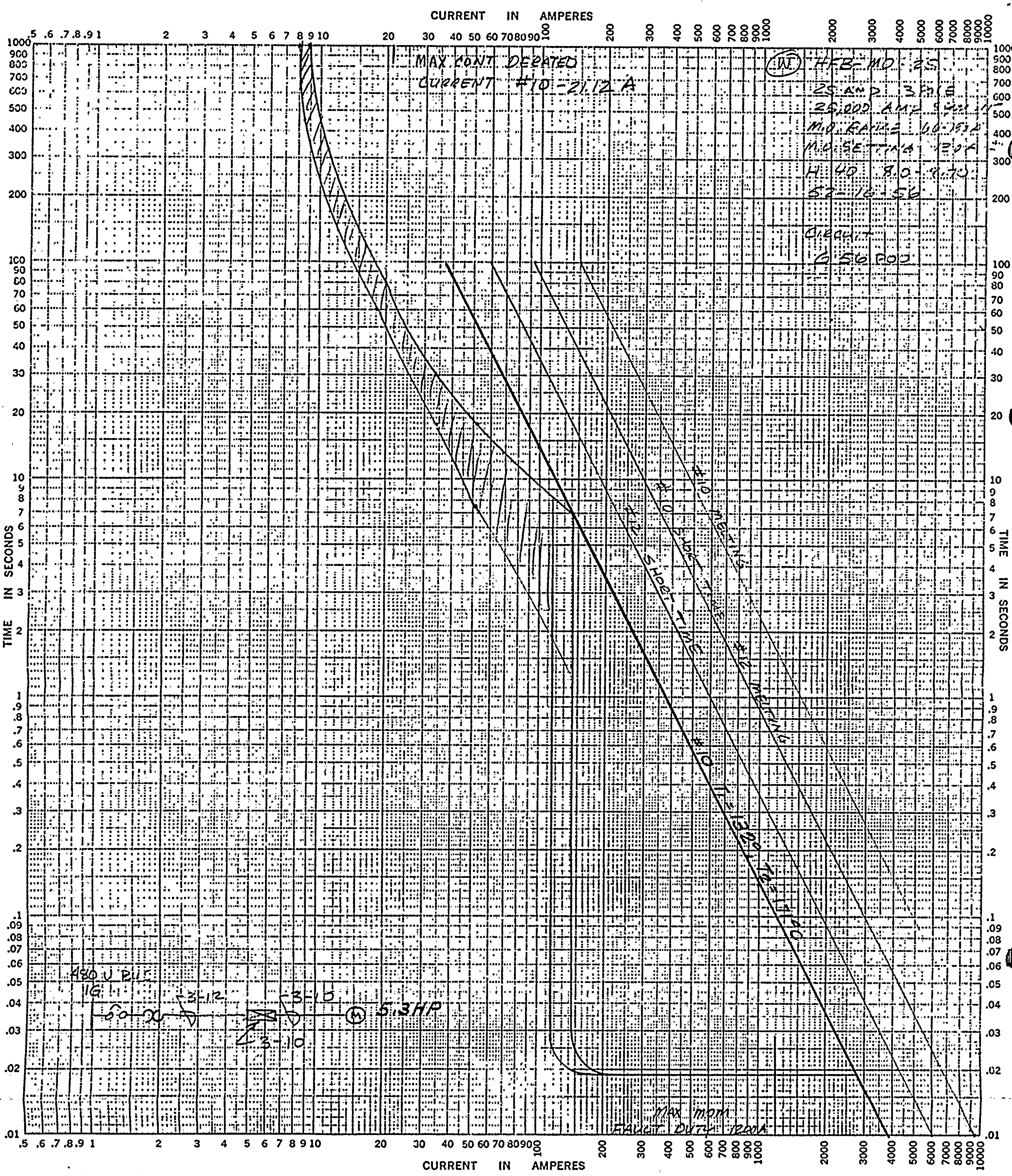
No. ______

Date JAN 17 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 8
REV: 8/17/79

PENETRATION 19E



8703 RHR RECIR. VV TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For ____ Fuse Links. In ____

BASIS FOR DATA Standards ____ Dated ____

1. Tests made at ____ Volts a-c at ____ p-f., starting at 25C with no initial load ____

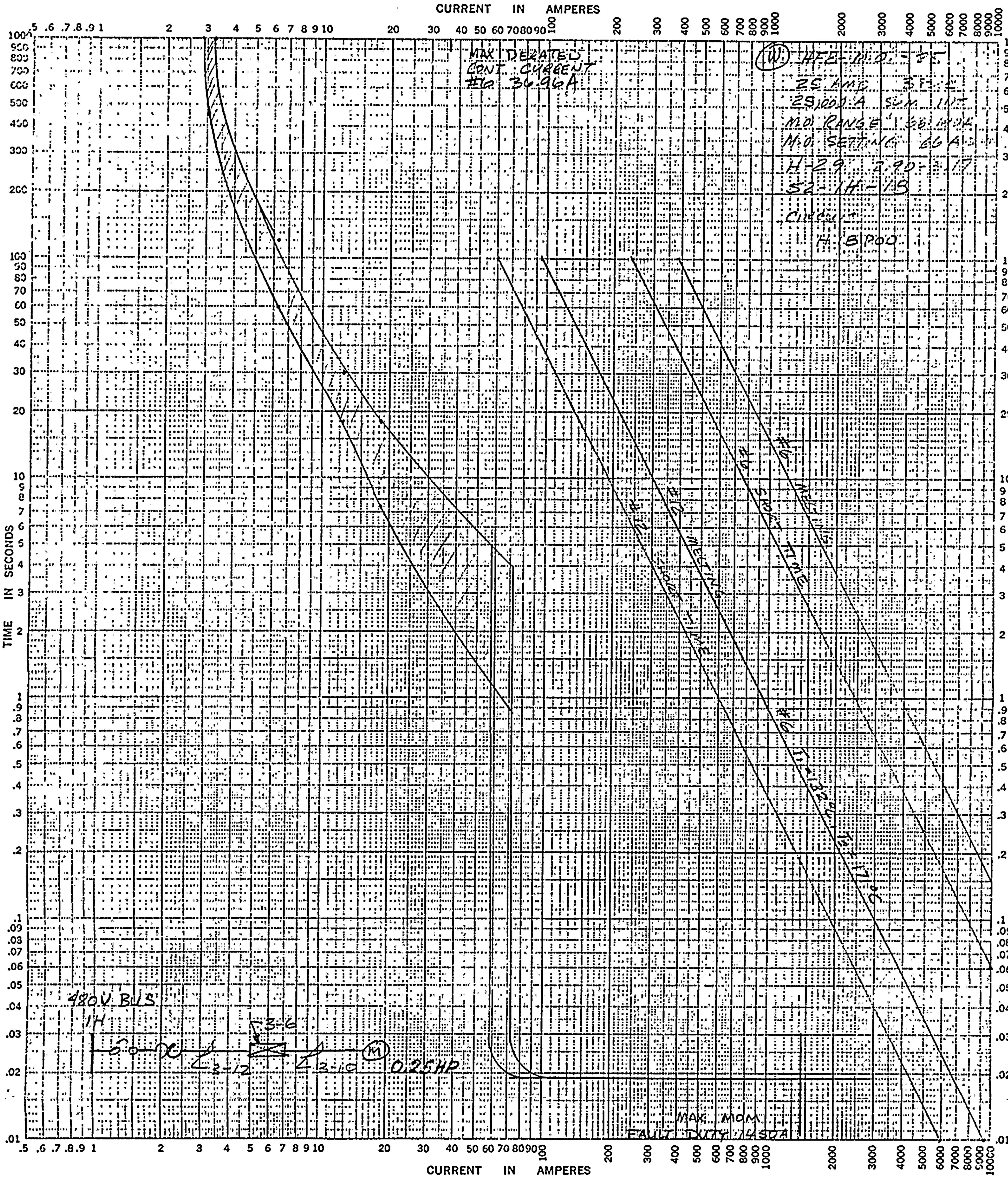
2. Curves are plotted to ____ Test points so variations should be ____

No. ____

Date JAN. 18, 1970

FIG 9
REV. 8/17/79

PENETRATION
12E

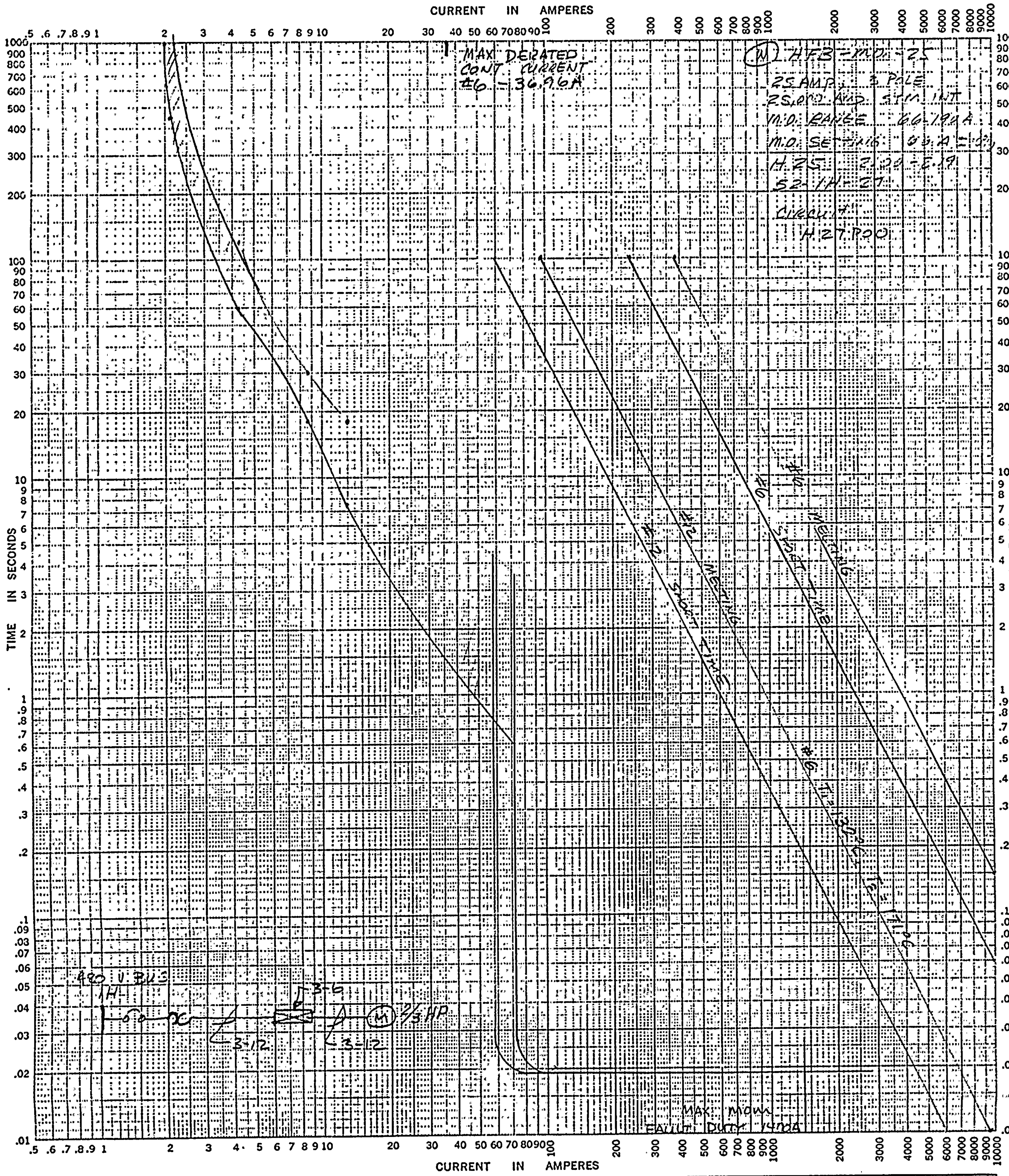


For RCP BEAR. OIL VV. FCV 749	TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION
	Fuse Links. In
BASIS FOR DATA Standards	Dated
1. Tests made at Volts a-c at p-f., starting at 25C with no initial load	No.
2. Curves are plotted to Test points so variations should be	Date JAN. 18, 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 10
REF. 8/17/77

PENETRATION
12E

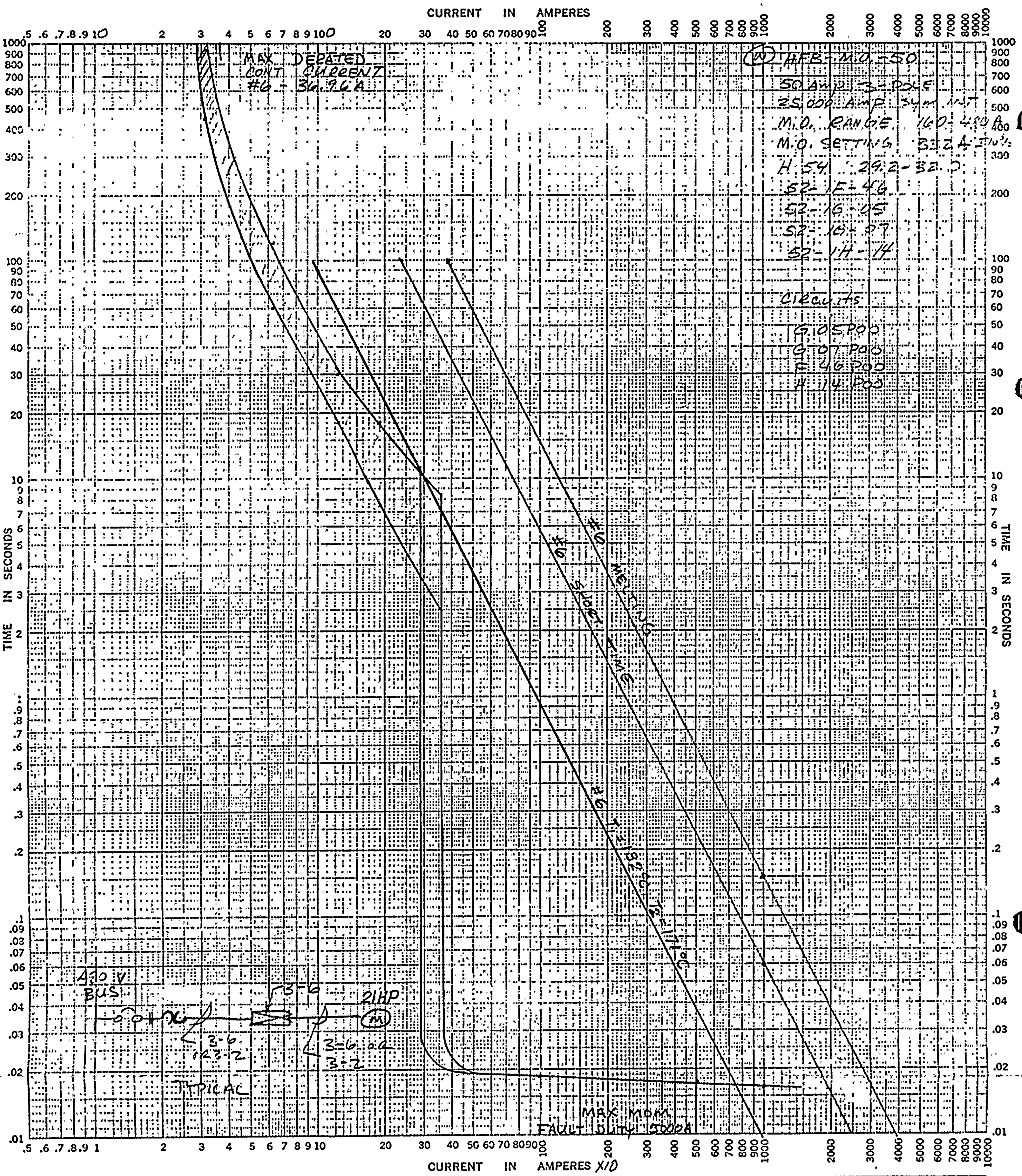


8112 RCP SEAL WTR RTN 150 VV TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION
For ______ Fuse Links. In ______
BASIS FOR DATA Standards ______ Dated ______
1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______
2. Curves are plotted to ______ Test points so variations should be ______
No. ______
Date JAN. 18 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 11
REV. 8/17/79

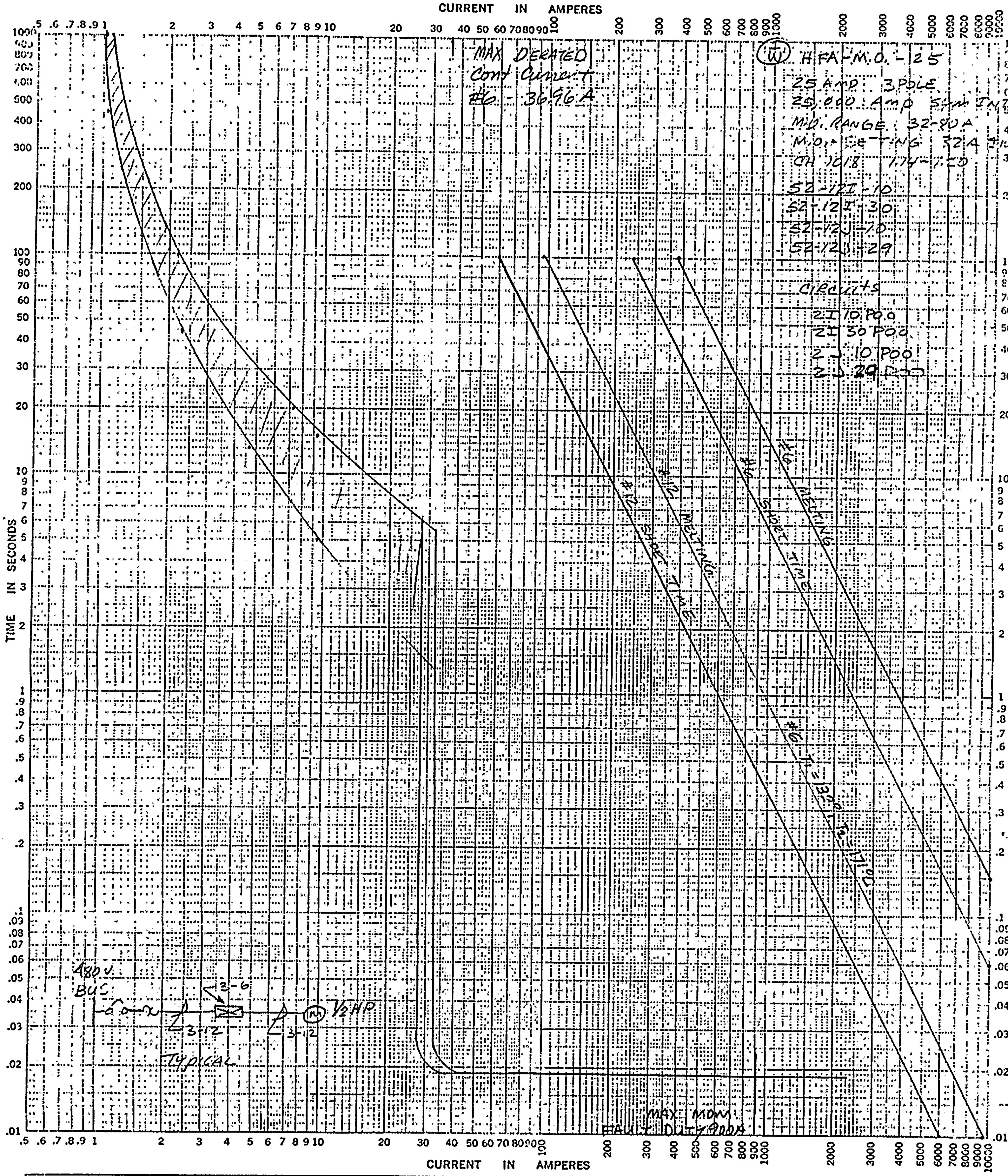
PENETRATION
12E, 19E, 26E



For ACCUM INJECT TO COLD LOOP VV	TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION Fuse Links. In
BASIS FOR DATA Standards	Dated
1. Tests made at ____ Volts a-c at ____ p-f., starting at 25C with no initial load	No.
2. Curves are plotted to ____ Test points so variations should be ____	Date JAN. 18, 1979

FIG. 12
REV 8/17/79

PENETRATIONS
23E, 11E

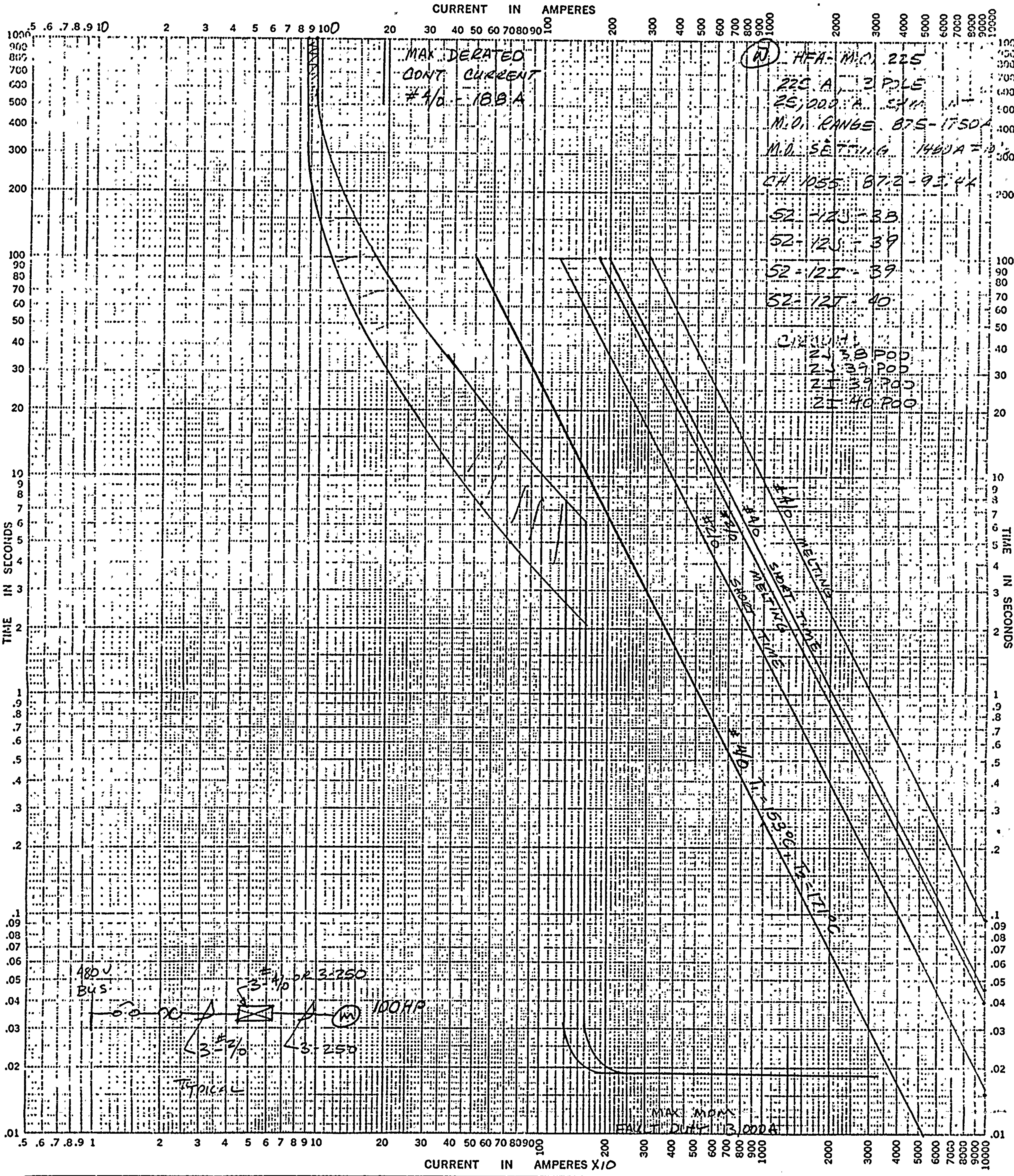


For CONT SUMP PP'S TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION Fuse Links. In	
BASIS FOR DATA Standards ______ Dated ______	
1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______	No. ______
2. Curves are plotted to ______ Test points so variations should be ______	Date JAN 19, 1977

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 13
REV. ...

PENETRATION
37E, 5E, 1E, 34E



For CRD BLD FN 11, 12, 13, & 14 TIME-CURRENT CHARACTERISTIC CURVES Fuse Links. In PRIMARY PROTECTION

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______

2. Curves are plotted to ______ Test points so variations should be ______

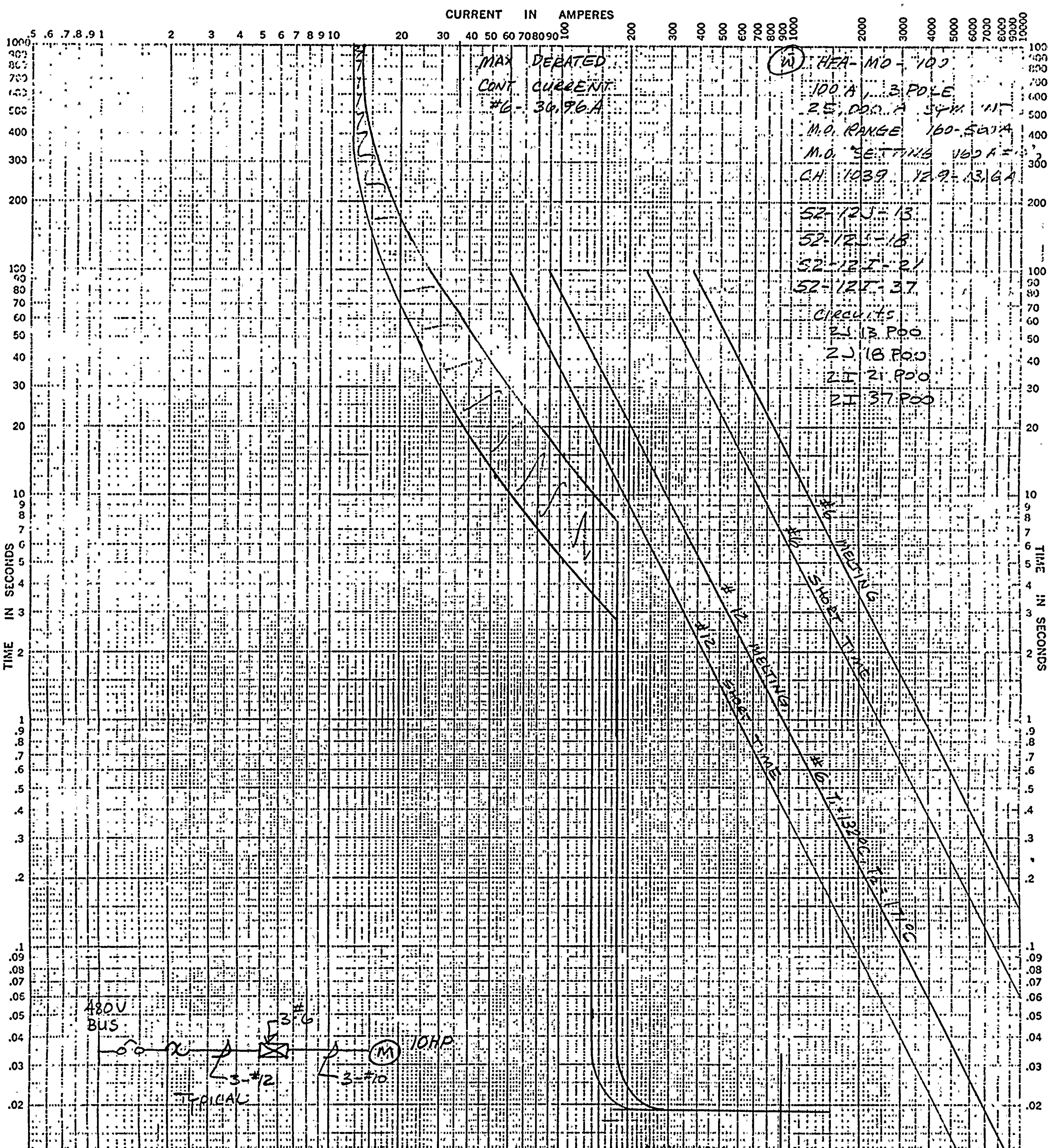
No. ______

Date JAN. 31, 1979

K•E TIME-CURRENT CHARACTERISTIC KEUFFEL & ESSER CO. MADE IN U.S.A. 48 5258

FIG 14
REV. 8/11

PENETRATION
11E, 23E

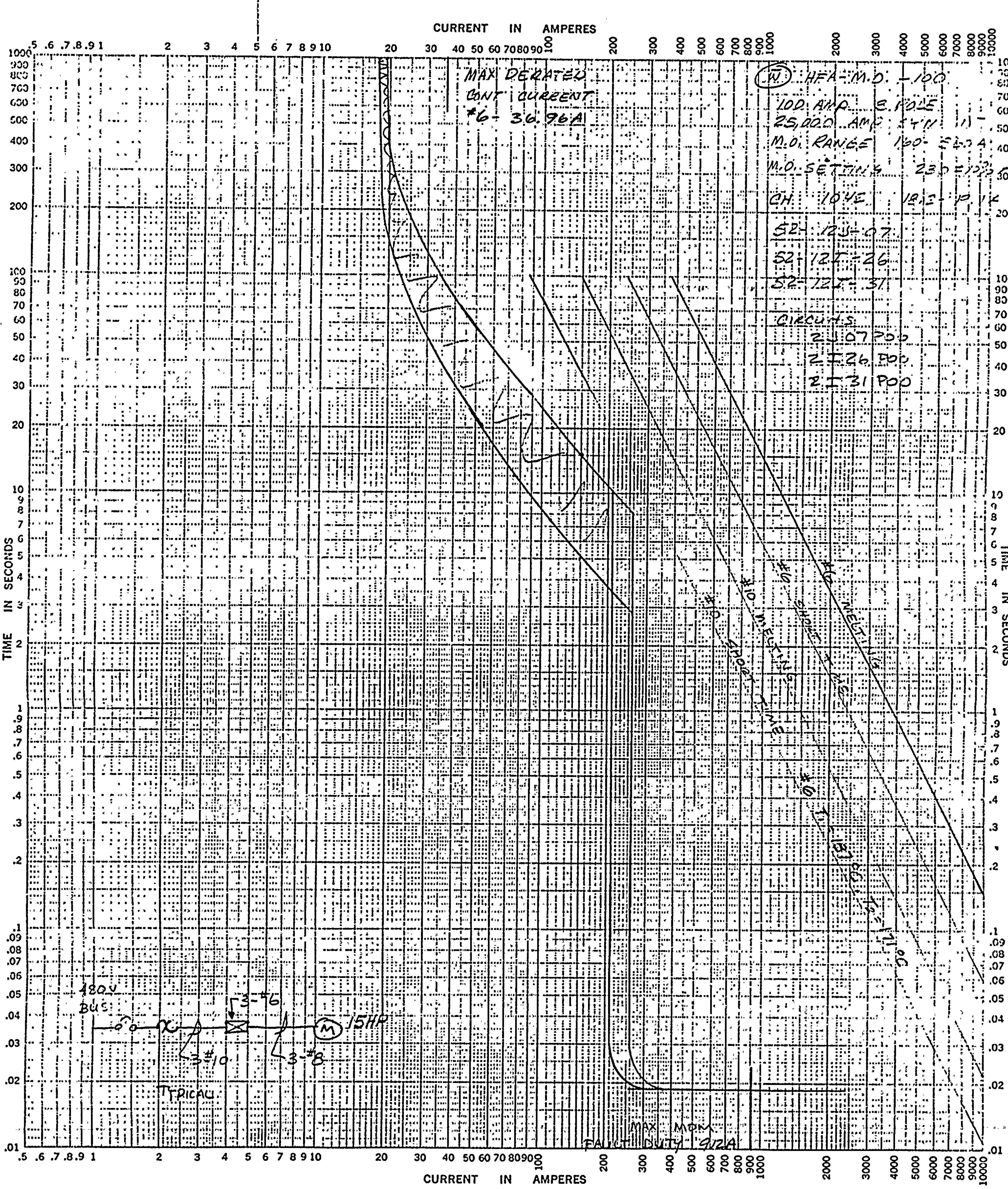


For RCP TBRG LPP 11, 12, 13, & 14 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION Fuse Links. In	
BASIS FOR DATA Standards Dated	
1. Tests made at Volts a-c at p-f., starting at 25C with no initial load	No.
2. Curves are plotted to Test points so variations should be	Date JAN 31, 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 15
REV. 9/17/79

PENETRATION
11E, 23E



For RC DRN TK PP 1-1, 1-2 & IODINE REM E-15 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

Fuse Links. In

BASIS FOR DATA Standards________ Dated________

1. Tests made at________ Volts a-c at________ p-f., starting at 25C with no initial load________

2. Curves are plotted to________ Test points so variations should be________

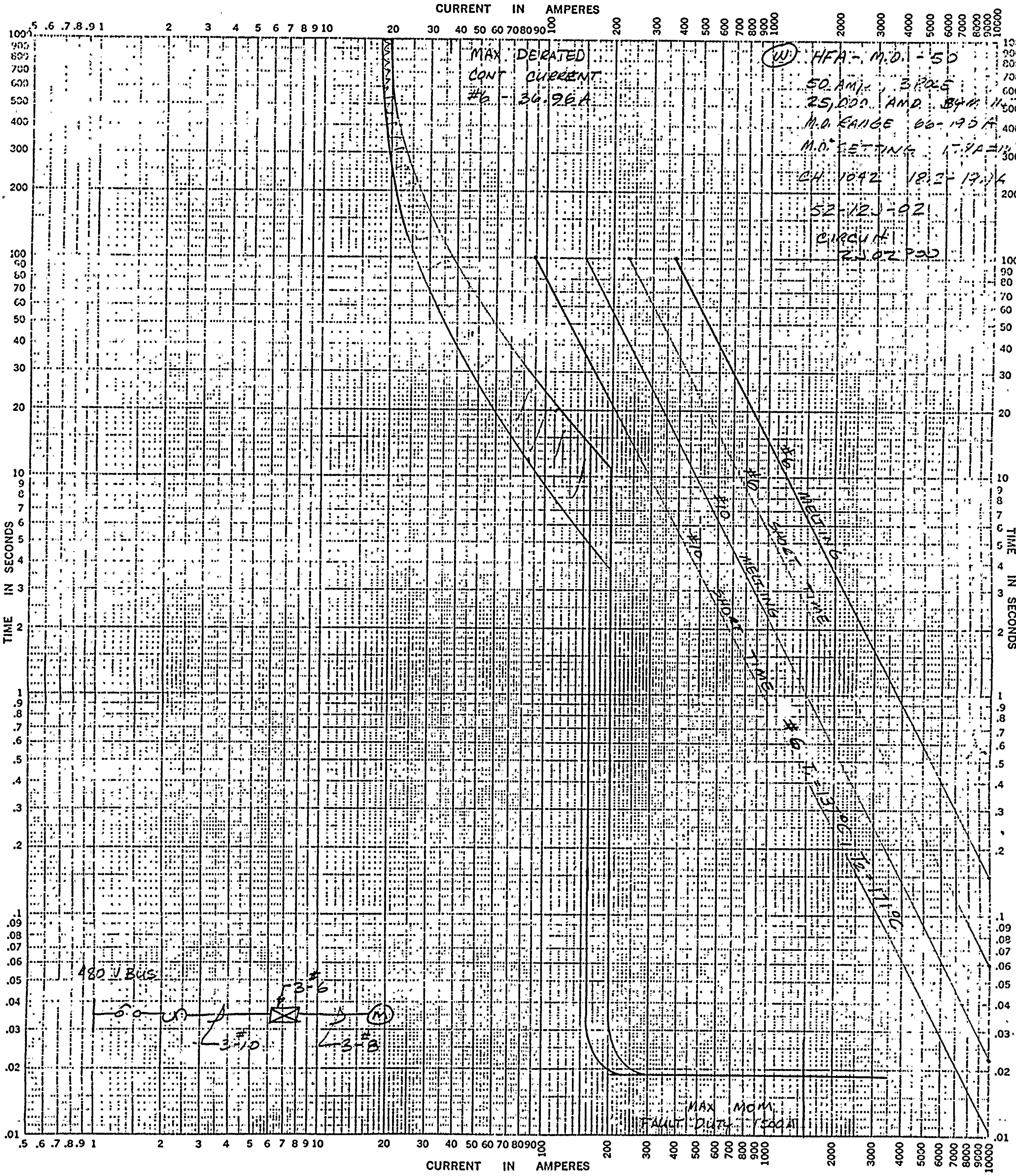
No.________

Date JAN. 31, 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 16
REV. 8/17/79

PENETRATION
11E



IODINE REM E16 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For______ Fuse Links. In______

BASIS FOR DATA Standards______ Dated______

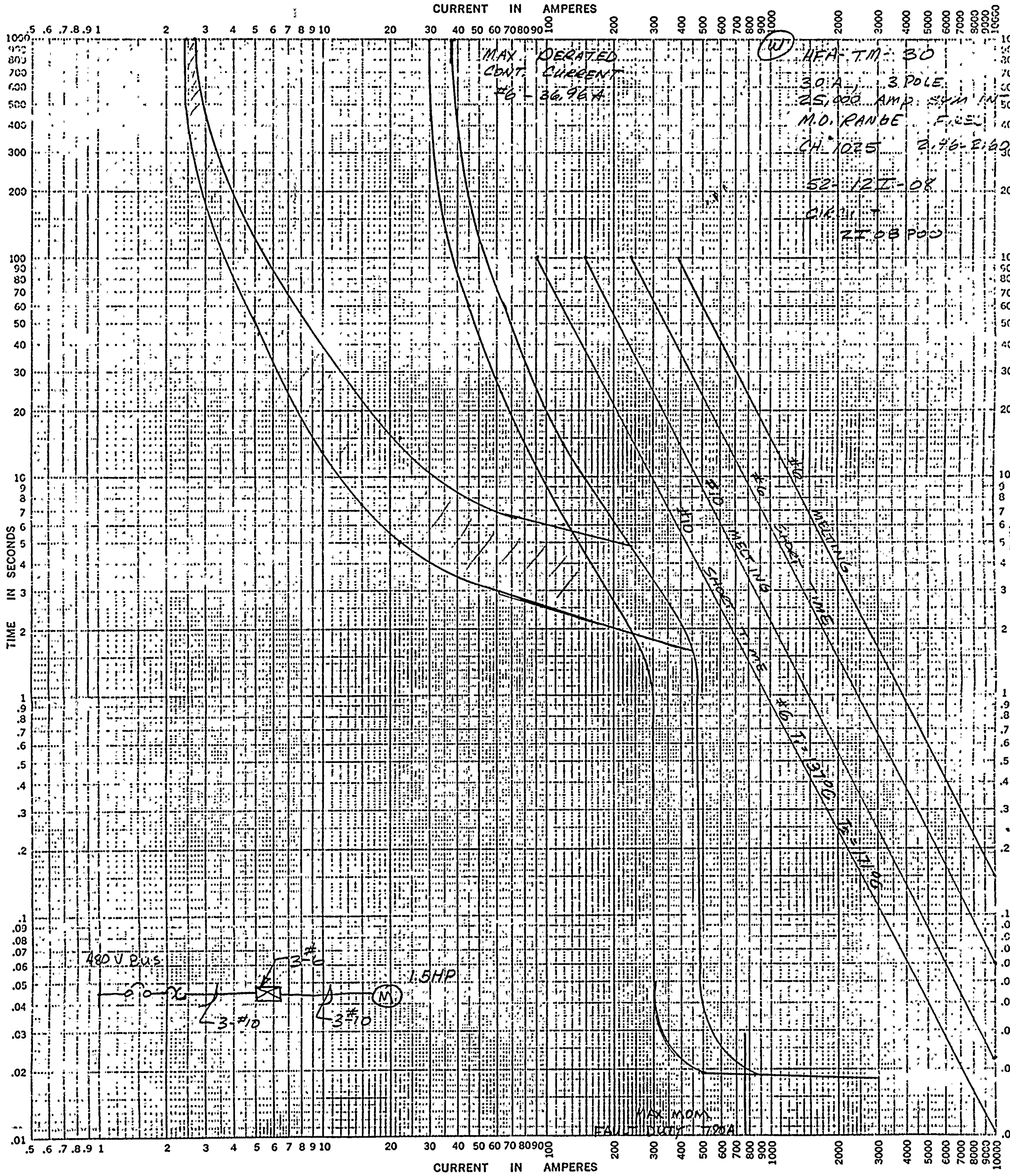
1. Tests made at______ Volts a-c at______ p-f., starting at 25C with no initial load______
2. Curves are plotted to______ Test points so variations should be______

No.______
Date JAN 31 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 17
REV.

PENETRATION
23E



CONT. AC FAN 216 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For ______ Fuse Links. In ______

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p.f., starting at 25C with no initial load ______

2. Curves are plotted to ______ Test points so variations should be ______

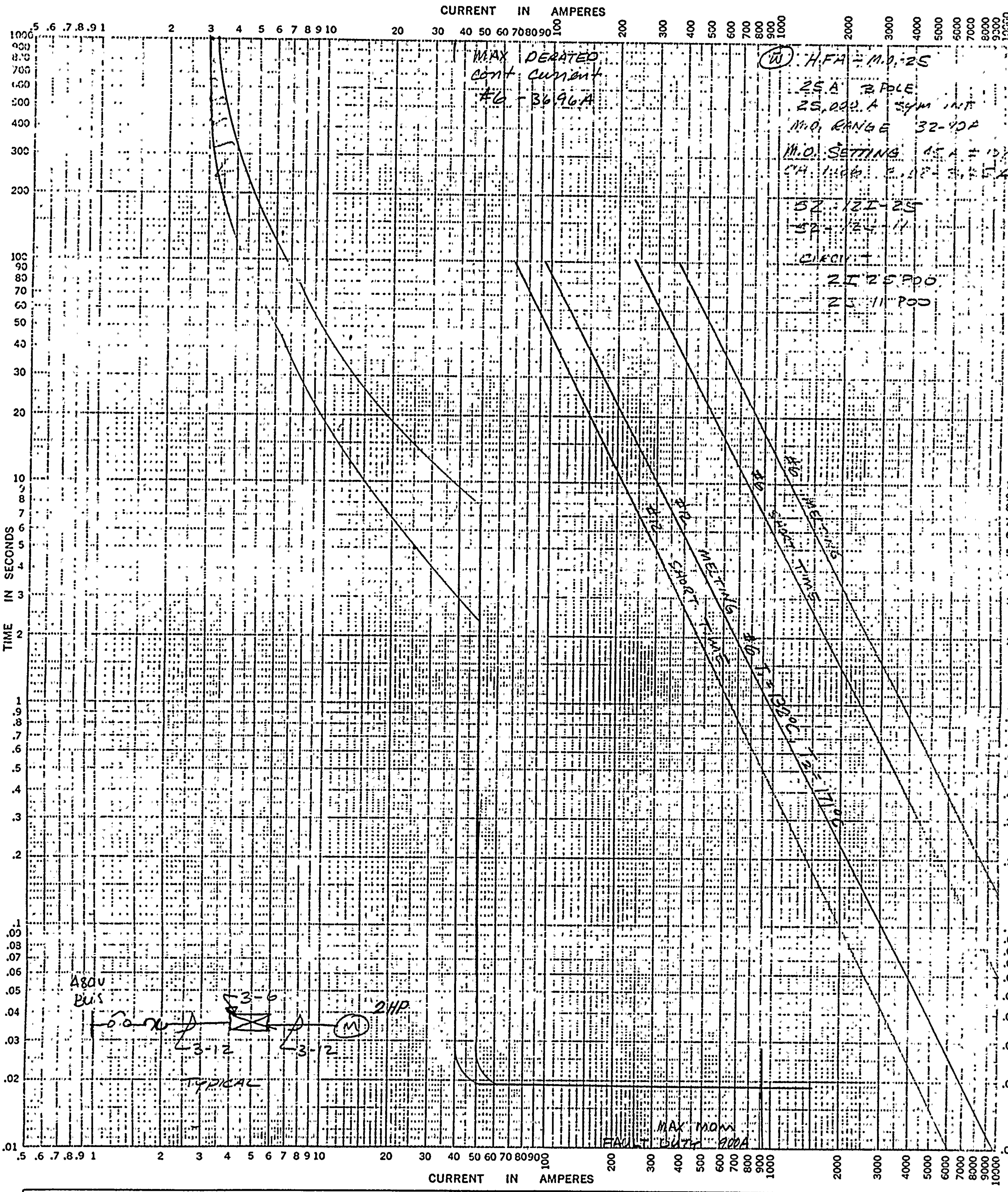
No. ______

Date JAN 31, 1977

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 18
REV. 8/17/77

PENETRATION
11E, 23E

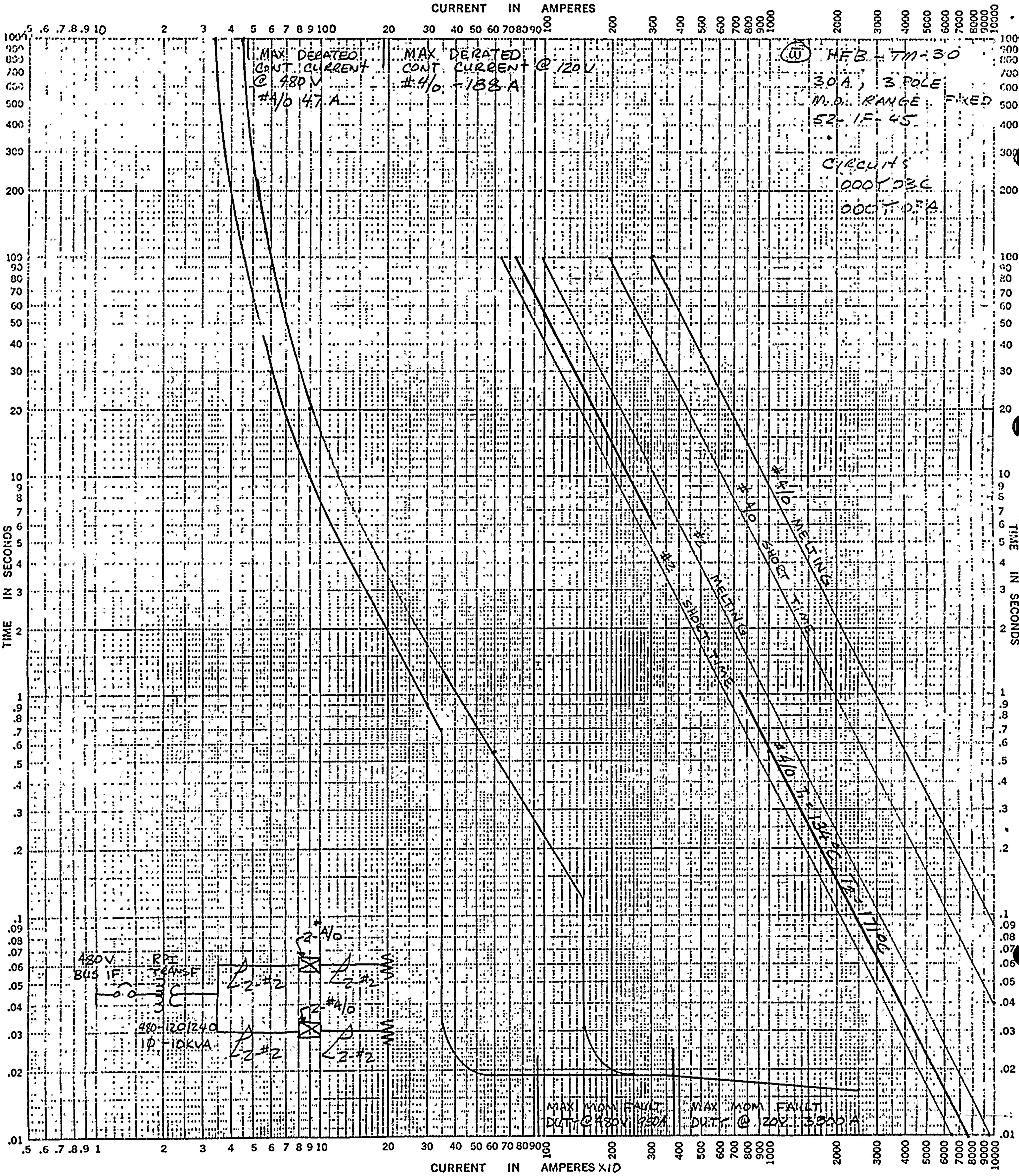


For REAC. CAV. SUMP PP'S TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION Fuse Links. In	
BASIS FOR DATA Standards Dated	
1. Tests made at Volts a-c at p-f., starting at 25C with no initial load	No.
2. Curves are plotted to Test points so variations should be	Date JAN 19, 1979

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 19
REV 8/17

PENETRATION
, 34E, 37E



NU. ROD HOT RACKS TIME-CURRENT CHARACTERISTIC CURVES PRIMARY SYSTEM

For_____ Fuse Links. In_____

BASIS FOR DATA Standards_____ Dated_____

1. Tests made at_____ Volts a-c at_____ p-f., starting at 25C with no initial load_____

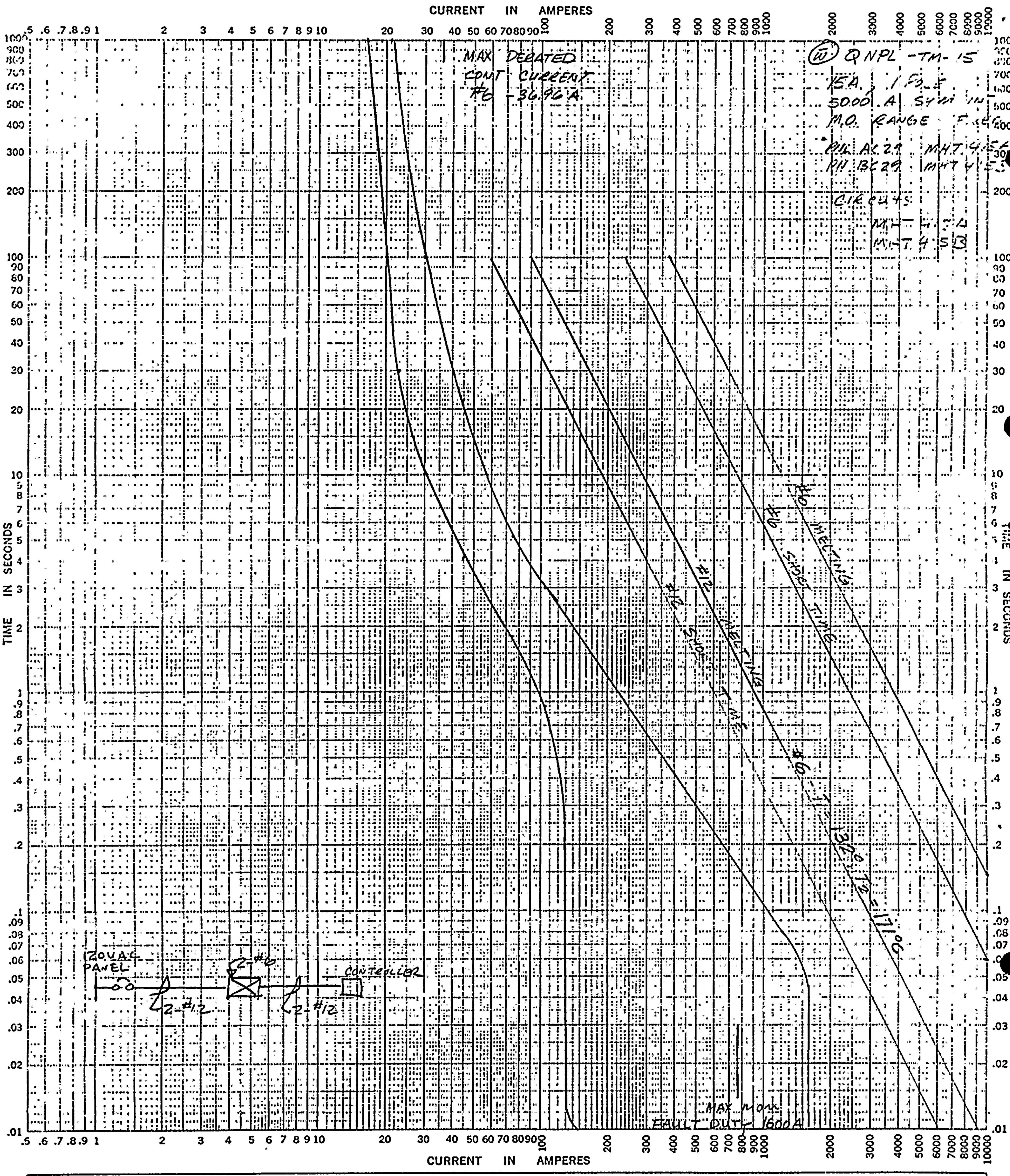
2. Curves are plotted to_____ Test points so variations should be_____

No._____

Date JAN. 21 1977

FIG. 20
REV 9.7-...

Penetration
12E, 26E



MHT415 A&B Heat Trace TIME-CURRENT CHARACTERISTIC CURVES Primary Penetration

For ______ Fuse Links. In ______

BASIS FOR DATA Standards ______ Dated ______

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load ______

2. Curves are plotted to ______ Test points so variations should be ______

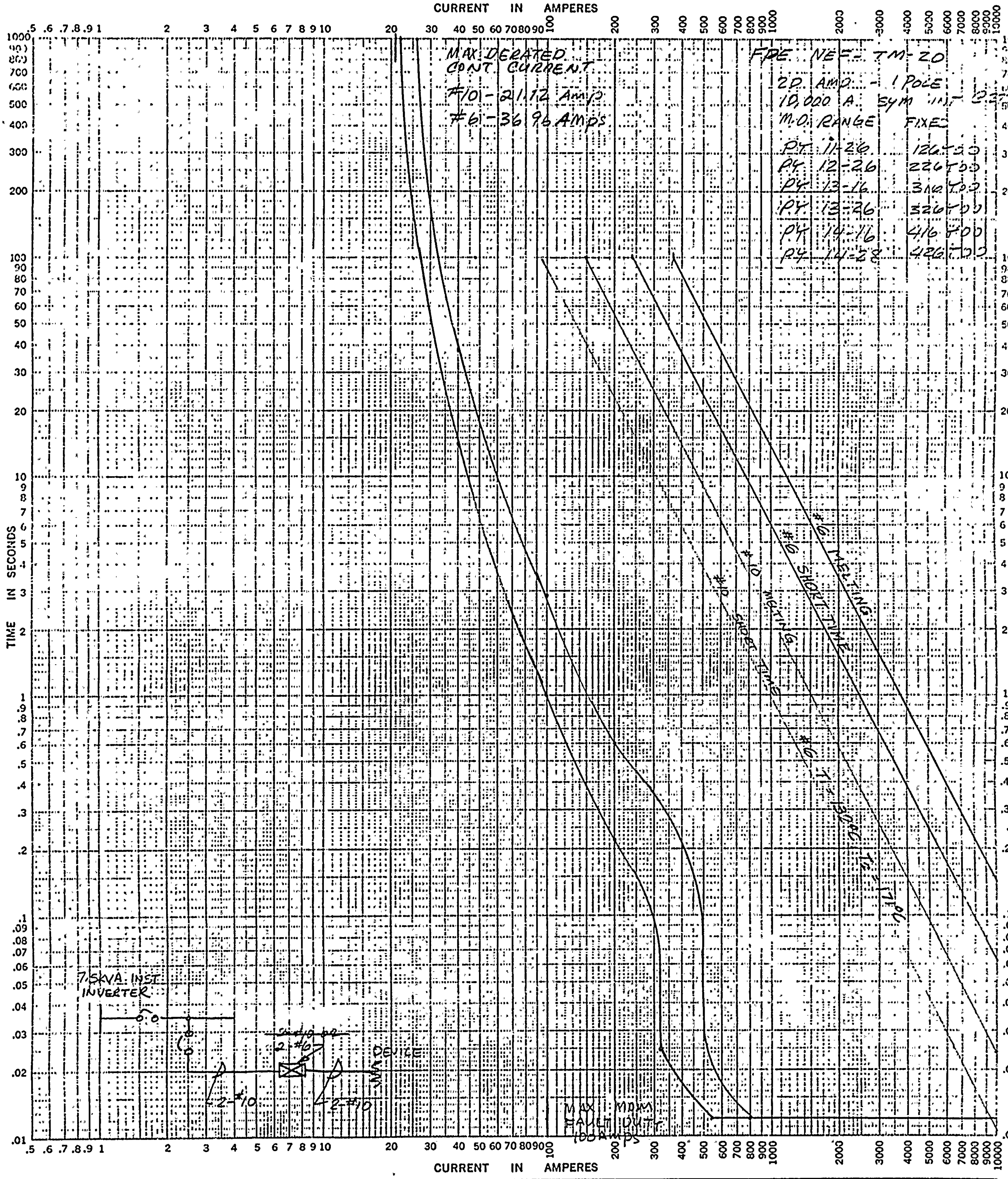
No. ______
Date JAN 31 1979

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

Fig 21

REV

PENETRATION
2E, 12E, 19E, 26E



For RCP LEAKAGE PRESS INST & INCORE INST TIME-CURRENT CHARACTERISTIC CURVES Primary Protection
Fuse Links. In

BASIS FOR DATA Standards __________ Dated __________

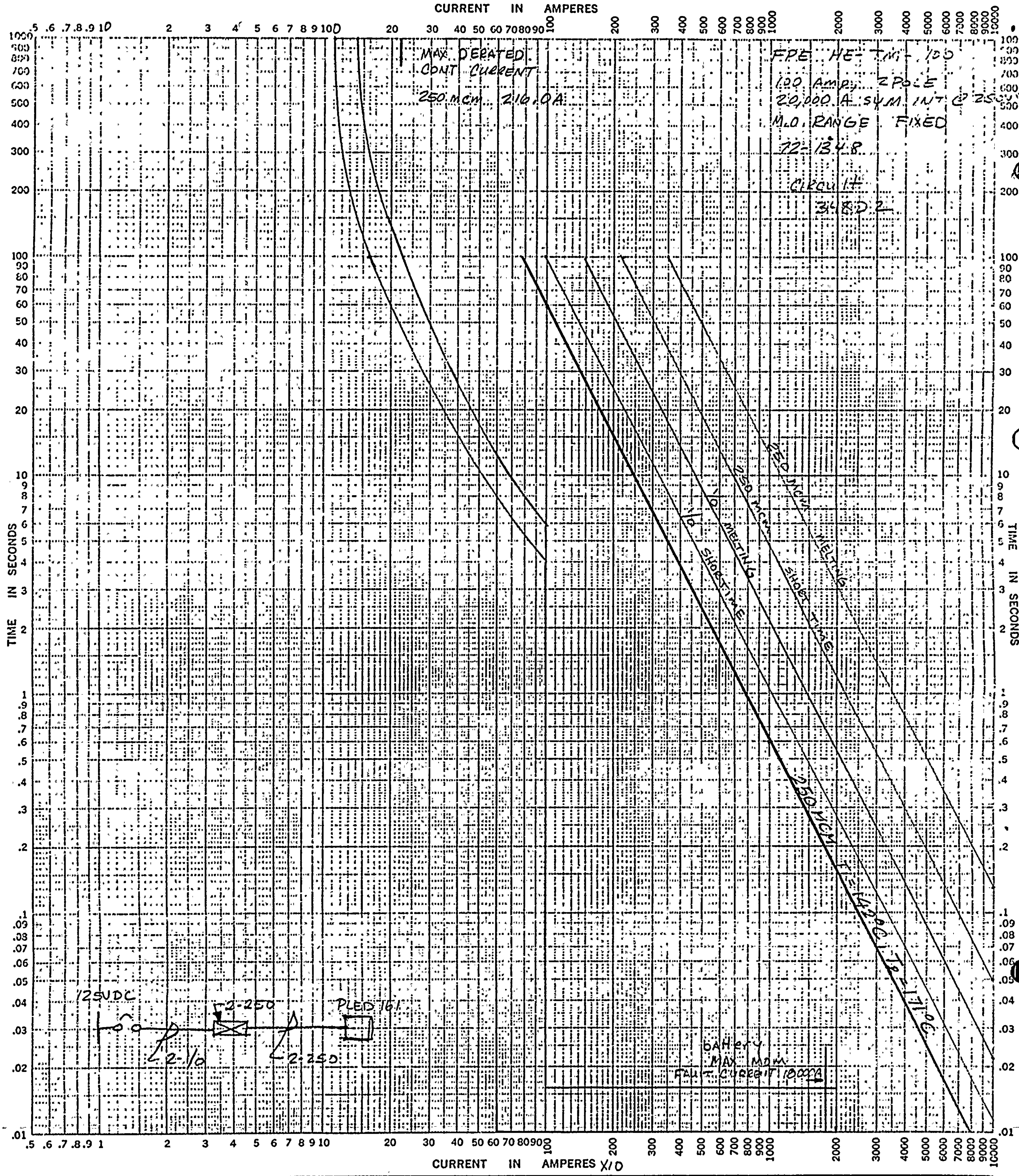
1. Tests made at __________ Volts a-c at __________ p-f., starting at 25C with no initial load
2. Curves are plotted to __________ Test points so variations should be __________

No. __________
Date JAN. 31, 1979

K&E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIG 22
REV.

PENETRATION
17E



(DC) EMEG. LTG. PNL PLED 161 TIME-CURRENT CHARACTERISTIC CURVES PRIMARY PROTECTION

For ____ Fuse Links. In ____

BASIS FOR DATA Standards ____ Dated ____

1. Tests made at ____ Volts a-c at ____ p-f., starting at 25C with no initial load ____ No. ____

2. Curves are plotted to ____ Test points so variations should be ____ Date JAN 31, 1979

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FIG 22
REV 8/17/79