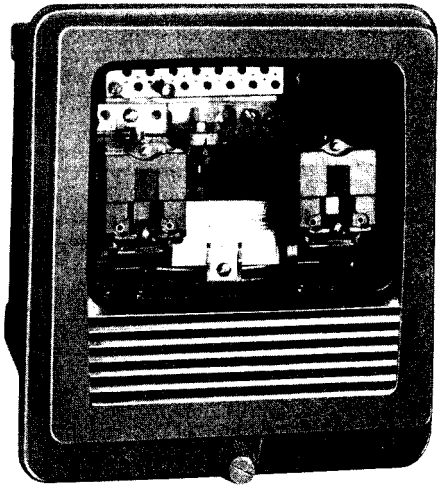
ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

September, 1990
Supersedes Descriptive Bulletin 41-100, pages 1-4, dated June, 1989
Mailed to: E, D, C/41-100A

Non-Directional, Single Phase
Adjustable Time Delay
Device No. 51 or 50/51

Type Hi-Lo CO Overcurrent Relays



Hi-Lo CO induction-disc type overcurrent relays are activated when the current in them exceeds given values. The circuit closing type relays are normally used to trip a circuit breaker. They may have either single or double contacts for tripping one or two circuit breakers.

The complete, coordinated line assures accurate, reliable primary and backup protection for phase or ground faults. Seven different time curves are available for system coordination.

Features
The traditional CO design advantages: Low burden, high thermal capacity, negligible temperature error.

Accurate pickup, continuous "between tap adjustment".

Simple, easy to get at, settings.

Space saving Flexitest® case for semi-flush or projection mounting.

Two Wide Ranges
The Hi-Lo CO relay offers two wide ranges; a high and a low.

Hi Range
The "Hi" range has an induction-disc time unit, rated 1 to 12 amperes with 14 taps. To complement the time unit, the relay is available with an instantaneous unit rated 6 to 144 amps with three tap positions. The core screw of the instantaneous unit is used to set the actual current pickup within any one of the three ranges.

The 1-12 amp. time unit along with the 6-144 amp. instantaneous unit in one relay style offers considerable savings in stocking and flexibility of application. This one rating will satisfy the phase and ground requirements in most cases.

Lo Range
The "Lo" range CO contains the same 0.5 to 2.5 amp induction-disc time unit with 7 taps as standard CO relay designs. However, the instantaneous unit has a wide range of 2 to 48 amperes using 3 taps. The core screw of the instantaneous unit is used to set the actual current pickup within the range used.

The 0.5-2.5 amp. time unit and 2-48 amp. instantaneous unit combination result in substantial stock advantage of relays for ground fault protection and other low current applications.

Induction Disc Unit Ranges & Taps

Ground (0.5-2.5A)
Lo Range 0.5, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5

Ground & Phase Unit (1-12A)
Hi Range 1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 3.5, 4, 5, 6, 7, 8, 10, 12

Instantaneous Unit Ranges & Taps

Ground (2-48A)
Lo Range 2-7, 7-14, 14-48

Ground or Phase Unit (6-144A)
Hi Range 6-20, 20-40, 40-144

Setting Adjustments
All adjustments are made from the front of the relay. The taps eliminate the need to switch leads. All settings are readily visible from the front of the relay through the glass window of the cover.

Interchangeability
Electrically and mechanically interchangeable with all existing CO relay installations.

Factors to Consider in Selecting Proper Relay Type

Apparatus or Circuit to be Protected: In general, the application will indicate the use of a specific relay. Short-time relays act fast to avoid equipment damage. Long-time relays hold off tripping on heavy initial overloads or more extended moderate overloads.

At higher fault currents, definite-time and moderately inverse relays maintain constant operating time, despite variation in connected generation and fault currents. Inverse and extremely inverse relays operate respectively faster on higher fault currents.

Selective Operation, Sequential Tripping: To maintain maximum continuity of service, as small a section as possible should be removed from a system during a fault. A common method is to set each successive relay, progressing from the generator, to operate 0.3 second sooner (plus circuit breaker operating time) so that the relay nearest the fault will operate first to remove the faulted section. See figure 1.

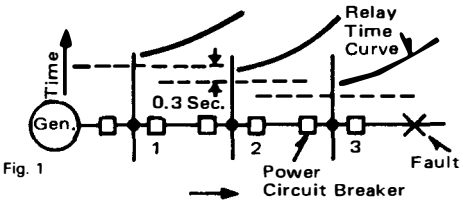


Fig. 1

Coordination With Adjacent Relays: To assure selective operation, relays in all sections of the protected line should have similar operating curves. Otherwise, curves may intercept, resulting in incorrect relay operation. See figure 2.

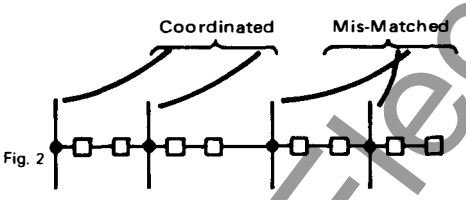


Fig. 2

Relay Tap Range: Magnitude of fault current available at a given location is usually determined by system studies. Tap range selection depends on the fault current as seen by the relay, which is determined by the current transformer ratio and its operating characteristics under fault conditions.

Selector Guide

Relay Type	Time Curve	Comparative Operating Time①	Basic Application
CO-2	Short	0.47 Sec.	Differential protection of bus or generators where restraint windings are not required. Straight overcurrent protection where short operating time is necessary.
CO-5	Long	25 Sec.	Motor locked rotor protection. Long time setting prevents tripping due to motor starting currents. Inverse characteristic provides faster tripping at higher currents.
CO-6	Definite	2 Sec.	For use where generating capacity and fault currents vary over a wide range. Relay has fixed operating time (per time dial setting) from approximately 10 to 20 times tap current, most useful where no coordination is required with downstream devices.
CO-7	Moderately Inverse	2.48 Sec.	Overcurrent phase and/or ground fault detection on transmission or feeder lines where moderate changes in generating capacity occur, or on parallel lines where one line may be called on to carry both loads. Relay approaches definite time characteristics at high currents, allowing wide changes in fault current magnitude with little change in operating time.
CO-8	Inverse	2.52 Sec.	Phase and/or ground fault detection of subtransmission lines or feeders. Also supplied as primary protection or back-up for other relays. Wide range in time lever settings and slope of curves facilitate coordination and assure selective operation. Degree of inverseness required is determined by fault current magnitude, operating time desired, and the characteristics of nearby relays on the system.
CO-9	Very Inverse	1.53 Sec.	
CO-11	Extremely Inverse	0.8 Sec.	Used on feeder circuit breakers which must coordinate with main and branch line sectionalizing fuses. Also used where long time delay is required for overload, such as where feeder is energized after extended outage.

① Values shown are with #10 time dial setting, and with 10 times tap value current applied.

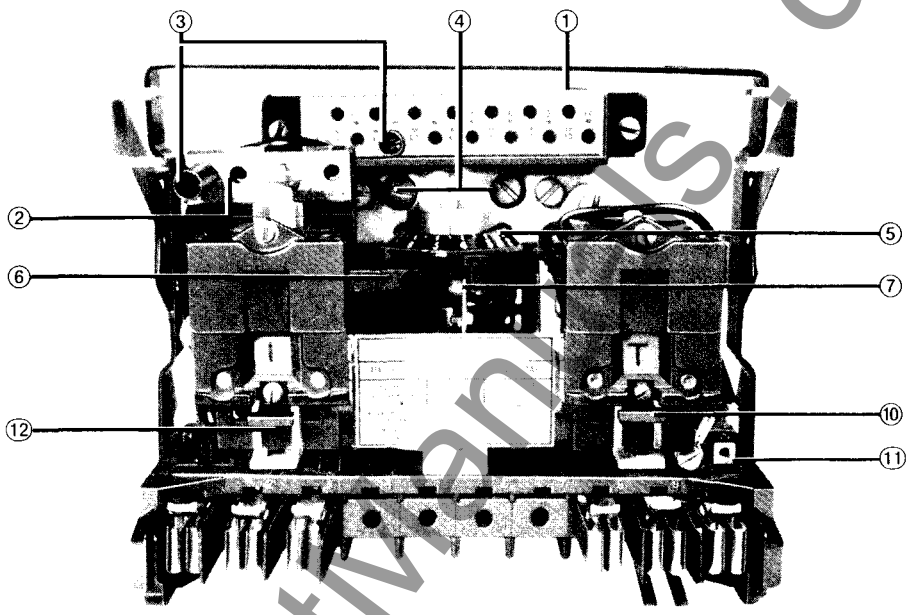
Ac or Dc Trip Circuit: Where a dc control source (24 to 250 volts) is available, circuit closing relays are used. If dc is not available, circuit opening relays are used with ac tripping, using the output of a current transformer to energize the circuit breaker trip coil. Under normal conditions, the normally closed contacts of the relay shunt the breaker trip coil.

High Speed Short Circuit Fault Protection: Relays equipped with instantaneous overcurrent IIT or ITH units provide instantaneous overcurrent tripping, in addition to tripping with time delay on moderate overloads.

Construction

A main tapped coil is placed on the center leg of an "E" type laminated structure. This produces a flux which divides and returns through the two outer legs. A shading coil on the left leg creates an out-of-phase flux which reacts with current induced in the disc by the main coil flux in the air gap to cause disc rotation in the contact-closing direction.

Types CO-2 and CO-11 relays are similar in electromagnet construction except that both outer legs have windings to produce the necessary out-of-phase fluxes required for contact-closing rotational torque.



(1) Time Unit Tap Block

(2) Instantaneous Unit Tap Block

(3) Tap Screws

(4) Magnetic Plugs

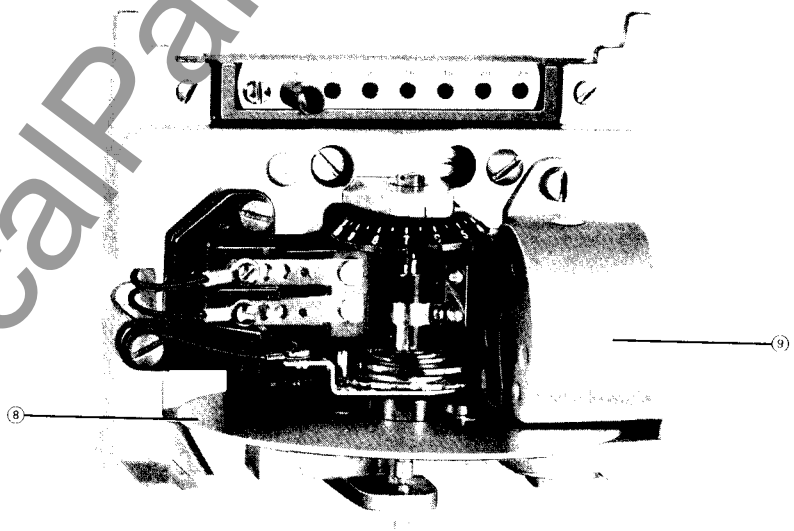
May be screwed in or out of the magnetic circuit to control saturation and adjust calibration at high currents. A damping magnet and spring adjustment permit calibration at low currents.

(5) Time Dial

Indicates starting position of the moving contact over a 270° range. Indexes from ½ (minimum time) to 11 (maximum time).

(6) Stationary Contact

Made of pure silver. Will close 30 amperes at 250 volts dc. Has sufficient wipe to assure positive contact. In fast breaker reclosing schemes which require quick-opening relay contacts, the metal plate is reversed, holding the stationary contact fixed against the back-stop. On double-trip relays, adjustment of 1/64" contact follow (or wipe) is obtained by use of a vernier adjusting screw on the stationary contact plate.



(7) Moving Contact

Also made of pure silver, the moving contact is clamped to the insulated section of the disc shaft. Electrical connection is made from the moving contact through a spiral spring to the spring adjuster frame, then to the relay terminal. Moving contacts will close 30 amperes at 250 volts dc.

(8) Induction Disc

Spiral shaped to compensate for the spring windup which occurs throughout the moving contact travel. Provides accurate pickup at any disc position. A spring adjuster is provided to permit in between tap pickup adjustment when desired.

(9) Damping Magnet

Made of high strength Alnico. Controls relay operating time at low current values. A keeper screw permits micrometer adjustment of the damping magnet without shifting the location of the magnet, and allows the relay to be accurately calibrated at low currents.

⑩ Indicating Contactor Switch (ICS)

(Partially Disassembled)

The dc operated Indicating Contactor Switch has a clapper type magnetic armature to which leaf-spring contacts are attached.

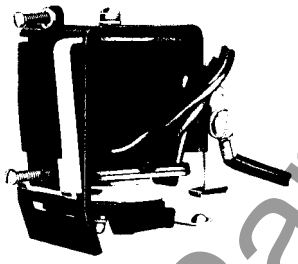
When the switch is energized, the moving contacts bridge the stationary contacts, completing the trip circuit. The ICS contacts are connected in parallel with the main relay contacts, relieving them of carrying heavy trip currents.

During operation, two fingers on the armature deflect a spring, which allows the operation indicator target to drop. The target is orange color and readily visible.

⑪ ICS Tap Selection

The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting the lead located in front of the tap block to the desired setting by means of a screw connection.

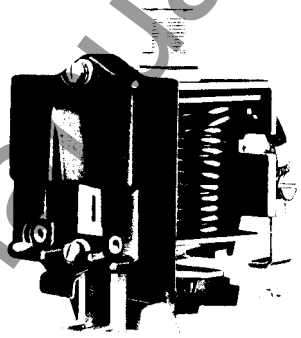
When using a 125 or 250 volt dc auxiliary WL auxiliary relay, the 0.2 ampere tap is recommended. The 2.0 ampere tap is used with WL relays on 24 or 48 volt dc circuits.



⑫ Indicating Instantaneous Trip (IIT)

Used for high speed detection of large fault currents. Construction is similar to that of the Indicating Contactor Switch, except that it is ac operated, and adjustable over the range. Variable pickup is obtained by a core screw adjustment on the top of the unit.

When the IIT is energized above pickup setting, the target drops.



Further Information
List Prices: PL 41-020
Technical Data: TD 41-025
Instructions: IL 41-100
Renewal Parts: RPD 41-914
Flexitest Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide TD 41-016

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December, 1990
Supersedes TD 41-020, Type Hi-Lo CO on pages 5 and 6, dated November, 1987
Mailed to: E, D, C/41-100A

Non-Directional, Single Phase
Adjustable Time Delay

Type Hi-Lo CO Overcurrent Relays

Type Hi-Lo CO Relay
Overcurrent, Non-Directional, Single-Phase, Non-Torque Controlled, 60 Hertz (Device Number: 51 & 50/51)

Type	Time Curve	Contacts	Indicating Contactor Switch③	Current Range Amps: Ac		Internal Schematic	Style Number	Case Size
				Time Unit	Instantaneous Unit IIT④			
Hi-Lo CO-2①	Short	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	265C195A01Ⓢ	**FT-11**
				1-12	None	57D4523	265C195A05Ⓢ	
				.5-2.5	2-48	3498A02	265C195A03	
				1-12	6-144	3498A02	265C195A07Ⓢ	
				.5-2.5	6-144	3498A02	265C195A09	
				1-12	2-48	3498A02	265C195A11	
		Dpst		.5-2.5	None	57D4524	265C195A02	
				1-12	None	57D4524	265C195A06	
				.5-2.5	2-48	3498A03	265C195A04	
				1-12	6-144	3498A03	265C195A08	
				.5-2.5	6-144	3498A03	265C195A10	
				1-12	2-48	3498A03	265C195A12	
		Spst②		.5-2.5	None	9647A50	265C195A41	
				1-12	None	9647A50	265C195A45	
				.5-2.5	2-48	9646A52	265C195A43	
				1-12	6-144	9646A52	265C195A47	
				.5-2.5	6-144	9646A52	265C195A49	
				1-12	2-48	9646A52	265C195A51	
Hi-Lo CO-5①	Long	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	264C897A01	**FT-11**
				1-12	None	57D4523	264C897A05Ⓢ	
				.5-2.5	2-48	3498A02	264C897A03	
				1-12	6-144	3498A02	264C897A07Ⓢ	
				.5-2.5	6-144	3498A02	264C897A09	
				1-12	2-48	3498A02	264C897A11	
		Dpst		.5-2.5	None	57D4524	264C897A02	
				1-12	None	57D4524	264C897A06	
				.5-2.5	2-48	3498A03	264C897A04	
				1-12	6-144	3498A03	264C897A08	
				.5-2.5	6-144	3498A03	264C897A10	
				1-12	2-48	3498A03	264C897A12	
		Spst②		.5-2.5	None	9647A50	264C897A41	
				1-12	None	9647A50	264C897A45	
				.5-2.5	2-48	9646A52	264C897A43	
				1-12	6-144	9646A52	264C897A47	
				.5-2.5	6-144	9646A52	264C897A49	
				1-12	2-48	9646A52	264C897A51	
Hi-Lo CO-6①	Definite	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	264C898A01Ⓢ	**FT-11**
				1-12	None	57D4523	264C898A05Ⓢ	
				.5-2.5	2-48	3498A02	264C898A03	
				1-12	6-144	3498A02	264C898A07Ⓢ	
				.5-2.5	6-144	3498A02	264C898A09	
				1-12	2-48	3498A02	264C898A11	
		Dpst		.5-2.5	None	57D4524	264C898A02	
				1-12	None	57D4524	264C898A06	
				.5-2.5	2-48	3498A03	264C898A04	
				1-12	6-144	3498A03	264C898A08	
				.5-2.5	6-144	3498A03	264C898A10	
				1-12	2-48	3498A03	264C898A12	
		Spst②		.5-2.5	None	9647A50	264C898A41	
				1-12	None	9647A50	264C898A45	
				.5-2.5	2-48	9646A52	264C898A43	
				1-12	6-144	9646A52	264C898A47	
				.5-2.5	6-144	9646A52	264C898A49	
				1-12	2-48	9646A52	264C898A51	

Ⓢ Denotes item available from stock.
① 50 Hertz relays and auxiliaries can be supplied at same price. Order "Similar to Style Number ..... except 50 Hertz".
② Styles have isolated Indicating Contactor Switch (ICS) and ITT, when applicable, contact outputs.
③ ICS: Indicating Contactor Switch (dc current operated) having seal in contacts and indicating target which are actuated when the ICS coil is energized at or above pickup current setting. Suitable for dc control voltages up to and including 250 volts dc. Two current ranges available:
(1) 0.2/2.0 amps dc, with tapped coil.
(2) 1.0 amp dc, without taps.

Rating of ICS unit used in specific types of relays is shown in price tables. All other ratings must be negotiated.

When ac current is necessary in a control trip circuit, the ICS unit can be replaced by an ACS unit. The ACS unit may be supplied in place of an ICS unit at no additional cost. Specify system voltage rating on order.

④ ITT: Indicating Instantaneous Trip rated per ranges shown in price tables. Unit is nondirectional, adjustable, and has target actuated when coil is energized at or above pickup setting. Unit has a dropout ratio of 65% at minimum setting and 90% at maximum setting.

Type Hi-Lo CO Relay
Overcurrent, Non-Directional, Single-Phase, Non-Torque Controlled, 60 Hertz, Continued

Type	Time Curve	Contacts	Indicating Contactor Switch③	Current Range Amps: Ac		Internal Schematic	Style Number	Case Size
				Time Unit	Instantaneous Unit IIT④			
Hi-Lo CO-7①	Moderately Inverse	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	264C899A01	**FT-11**
				1-12	None	57D4523	264C899A05Ⓢ	
				.5-2.5	2-48	3498A02	264C899A03Ⓢ	
				1-12	6-144	3498A02	264C899A07Ⓢ	
				.5-2.5	6-144	3498A02	264C899A09	
				1-12	2-48	3498A02	264C899A11	
		Dpst		.5-2.5	None	57D4524	264C899A02	
				1-12	None	57D4524	264C899A06	
				.5-2.5	2-48	3498A03	264C899A04	
				1-12	6-144	3498A03	264C899A08	
				.5-2.5	6-144	3498A03	264C899A10	
				1-12	2-48	3498A03	264C899A12	
		Spst②		.5-2.5	None	9647A50	264C899A41	
				1-12	None	9647A50	264C899A45	
				.5-2.5	2-48	9646A52	264C899A43	
				1-12	6-144	9646A52	264C899A47	
				.5-2.5	6-144	9646A52	264C899A49	
				1-12	2-48	9646A52	264C899A51	
Hi-Lo CO-8①	Inverse	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	264C900A01Ⓢ	**FT-11**
				1-12	None	57D4523	264C900A05Ⓢ	
				.5-2.5	2-48	3498A02	264C900A03Ⓢ	
				1-12	6-144	3498A02	264C900A07Ⓢ	
				.5-2.5	6-144	3498A02	264C900A09	
				1-12	2-48	3498A02	264C900A11	
		Dpst		.5-2.5	None	57D4524	264C900A02	
				1-12	None	57D4524	264C900A06	
				.5-2.5	2-48	3498A03	264C900A04	
				1-12	6-144	3498A03	264C900A08	
				.5-2.5	6-144	3498A03	264C900A10	
				1-12	2-48	3498A03	264C900A12	
		Spst②		.5-2.5	None	9647A50	264C900A41	
				1-12	None	9647A50	264C900A45	
				.5-2.5	2-48	9646A52	264C900A43	
				1-12	6-144	9646A52	264C900A47	
				.5-2.5	6-144	9646A52	264C900A49	
				1-12	2-48	9646A52	264C900A51	
Hi-Lo CO-9①	Very Inverse	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	264C901A01Ⓢ	**FT-11**
				1-12	None	57D4523	264C901A05Ⓢ	
				.5-2.5	2-48	3498A02	264C901A03Ⓢ	
				1-12	6-144	3498A02	264C901A07Ⓢ	
				.5-2.5	6-144	3498A02	264C901A09	
				1-12	2-48	3498A02	264C901A11	
		Dpst		.5-2.5	None	57D4524	264C901A02	
				1-12	None	57D4524	264C901A06	
				.5-2.5	2-48	3498A03	264C901A04	
				1-12	6-144	3498A03	264C901A08Ⓢ	
				.5-2.5	6-144	3498A03	264C901A10	
				1-12	2-48	3498A03	264C901A12	
		Spst②		.5-2.5	None	9647A50	264C901A41	
				1-12	None	9647A50	264C901A45	
				.5-2.5	2-48	9646A52	264C901A43	
				1-12	6-144	9646A52	264C901A47	
				.5-2.5	6-144	9646A52	264C901A49	
				1-12	2-48	9646A52	264C901A51	

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(1) 0.2/2.0 amps dc, with tapped coil.
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Overcurrent, Non-Directional, Single-Phase, Non-Torque Controlled, 60 Hertz, Continued

Type	Time Curve	Contacts	Indicating Contactor Switch③	Current Range Amps: Ac		Internal Schematic	Style Number	Case Size
				Time Unit	Instantaneous Unit IIT④			
Hi-Lo CO-11①	Extremely Inverse	Spst	0.2/2.0 Amp dc	.5-2.5	None	57D4523	265C047A01Ⓢ	**FT-11**
				1-12	None	57D4523	265C047A05Ⓢ	
				.5-2.5	2-48	3498A02	265C047A03Ⓢ	
				1-12	6-144	3498A02	265C047A07Ⓢ	
				.5-2.5	6-144	3498A02	265C047A09	
				1-12	2-48	3498A02	265C047A11Ⓢ	
		Dpst		.5-2.5	None	57D4524	265C047A02	
				1-12	None	57D4524	265C047A06	
				.5-2.5	2-48	3498A03	265C047A04	
				1-12	6-144	3498A03	265C047A08	
				.5-2.5	6-144	3498A03	265C047A10	
				1-12	2-48	3498A03	265C047A12	
		Spst②		.5-2.5	None	9647A50	265C047A41	
				1-12	None	9647A50	265C047A45	
				.5-2.5	2-48	9646A52	265C047A43	
				1-12	6-144	9646A52	265C047A47	
				.5-2.5	6-144	9646A52	265C047A49	
				1-12	2-48	9646A52	265C047A51	

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