



Commissioning guide

Dynec⁺ with Unidrive M700, M701, M702 with position feedback

*Motors 11 to 240 kW
interchangeable version
1,500 and 3,000 series
with drive*

Reference: 6085 en - 2022.02 / a

LEROY-SOMERTM

1 - INTRODUCTION

Before setting up the drive, please follow the safety and installation instructions for Dyneo+ motors and Unidrive M70x drives described in their respective manuals.

Dyneo+ motors:

http://www.leroy-somer.com/documentation_pdf/5411_en.pdf

Unidrive M70x drive:

See the Getting Started Guide and associated Power Installation Guide (available from the Control Techniques website).



- **The installation and commissioning must be carried out by qualified, competent and authorised personnel.**

Then proceed with the quick commissioning described in 2 from the factory setting.

Requirements:

- Ensure the drive has a firmware version equal or higher than V01.20.00.00.

2 - COMMISSIONING WITH UNIDRIVE M70x WITH POSITION FEEDBACK

RFC-S mode for interchangeable Dyneo⁺ permanent magnet motors without position feedback

Action	Description
Before power-up	Ensure: - The drive enable signal is not given (terminal 31 on Unidrive M700/M701 and terminals 11 & 13 on Unidrive M702) - The Run signal is not given - Motor and feedback device are connected
Power-up the drive	If RFC-S mode is displayed when the drive is powered up: - If the frequency of the mains supply is 60Hz, set Pr 00.000 = 1244, otherwise if the frequency of the mains is 50Hz, set Pr 00.000 = 1233. If Open Loop or RFC-A mode is displayed when the drive is powered up: - Set Pr 00.048 = RFC-S (3). - If the frequency of the mains supply is 60Hz, set Pr 00.000 = 1254, otherwise if the frequency of the mains is 50Hz, set Pr 00.000 = 1253. Press the red Reset button or toggle the Reset logic input. These actions will leave the drive in RFC-S mode with defaulted parameters. The drive will be in a tripped state, but the associated trips are addressed by settings within this procedure.
Advanced menu access from the keypad	To access all menus required for commissioning, set Pr 00.0049 = All Menus (1). Reminder: Select the menus using the left and right arrows. The parameters are selected using the up and down arrows.
Set motor feedback parameters	Set the following parameters depending on the position feedback device type used: <u>Resolver</u> - P1 Device Type (Pr 03.038) = Resolver (14) - P1 Resolver Poles (Pr 03.065) = 2 (resolver provided by Nidec Leroy-Somer) - P1 Resolver Excitation (Pr 03.066) = 6kHz 2V FAST (6) (resolver provided by Nidec Leroy-Somer) <u>SC EnDat</u> - P1 Device Type (Pr 03.038) = SC EnDat (9) - P1 Supply Voltage (Pr 03.036) = 5V (0) - P1 Comms Baud Rate (Pr 03.037) = 2M (7) - P1 Error Detection Level (Pr 03.040) = 3 (Bit 1 set to enable Phase Error Detection) Press the Reset button or toggle the Reset logic input initialise the encoder. For SC EnDat and EnDat encoders, the remaining encoder parameters are auto configured. The fitting of options (forced ventilation for example) affects the mounting position of the position feedback device, which may result in the reversal of the position feedback polarity. To check the polarity, monitor Speed Feedback (Pr 03.002) and rotate the motor in the intended forward direction. If the monitored value is negative, then P1 Feedback Reverse (Pr 03.056) = on (1) to correct the feedback polarity.
Motor thermistor set-up	The motor PTC thermistor must be connected to the drive: - M700/M701: Connect thermistor to analogue input 3 (terminals 8 and 11). - M702 (with date code 1710 or later): Connect thermistor to digital input 5 / analogue input 3 (terminals 8 and 10). For the drive to manage the thermistor: - Set Analogue Input 3 Mode Pr 07.015 = Therm short Cct (7). If connection of the thermistor leaves insufficient inputs, then it may be necessary to fit an SI-I/O module.

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Enter motor nameplate details	Refer to the Dyneo+ motors tables located in the Appendix. Select the table corresponding to the motor speed range (1500 or 3000 rpm). Then depending on the motor type and its power, select the line that corresponds to the voltage, the supply frequency and the rated speed of the application. From this line, set in the drive the values of all the parameters listed in the table. If the load is a high inertia, Pr 03.010 may need to be increased.																																																																																																																																									
	NOTE : If the motor type does not appear in the table, then it is from the Compact range. In this case, please contact Control Techniques Technical Support.																																																																																																																																									
	Example: For the 1500 range motor, LSHRM 160MR1 - 11 kW 400V - 50Hz with a rated speed of 1500 rpm, parameter values to set in the drive are the ones of the green line as indicated below:																																																																																																																																									
	<table><tr><th colspan="18">1500 rpm RANGE</th></tr><tr><th rowspan="3">MOTOR Type</th><th rowspan="3">kW</th><th rowspan="3">M70x</th><th rowspan="3">Coupling</th><th rowspan="3">Hz</th><th colspan="13">PARAMETERS</th></tr><tr><th>#03.010</th><th>#03.011</th><th>#04.015</th><th>#05.007</th><th>#05.008</th><th>#05.009</th><th>#05.017</th><th>#05.033</th><th>#05.069</th><th>#05.075</th><th>#05.078</th><th>#05.082</th><th>#05.084</th><th>#05.087</th></tr><tr><th>Speed Gain Kp</th><th>Speed Gain Ki</th><th>Thermal constant (s)</th><th>Rated current (A)</th><th>Rated speed (rpm)</th><th>Rated voltage (V)</th><th>Stator Resistance (Ω)</th><th>BEMF (V/krpm)</th><th>Over-current trip level (%)</th><th>Iq (%)</th><th>Lq @ Iq (mH)</th><th>Id (%)</th><th>Lq @ Id (mH)</th><th>Torque Angle (°)</th></tr><tr><td rowspan="4">LSHRM 160 MR1</td><td>11</td><td>44-00172</td><td>Y</td><td>50</td><td>0.005</td><td>0.05</td><td>800</td><td>21.0</td><td>1500</td><td>400</td><td>0.31582</td><td>72.1</td><td>236</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>11</td><td>44-00172</td><td>Y</td><td>60</td><td>0.005</td><td>0.05</td><td>800</td><td>20.3</td><td>1800</td><td>400</td><td>0.31582</td><td>72.1</td><td>244</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>12.7</td><td>44-00172</td><td>Y</td><td>60</td><td>0.005</td><td>0.05</td><td>800</td><td>21.2</td><td>1800</td><td>460</td><td>0.31582</td><td>72.1</td><td>233</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>19.1</td><td>64-00420</td><td>D</td><td>87</td><td>0.005</td><td>0.05</td><td>800</td><td>38.2</td><td>2600</td><td>400</td><td>0.10527</td><td>41.6</td><td>218</td><td>73</td><td>14.948</td><td>-108</td><td>22.850</td><td>56</td></tr></table>	1500 rpm RANGE																		MOTOR Type	kW	M70x	Coupling	Hz	PARAMETERS													#03.010	#03.011	#04.015	#05.007	#05.008	#05.009	#05.017	#05.033	#05.069	#05.075	#05.078	#05.082	#05.084	#05.087	Speed Gain Kp	Speed Gain Ki	Thermal constant (s)	Rated current (A)	Rated speed (rpm)	Rated voltage (V)	Stator Resistance (Ω)	BEMF (V/krpm)	Over-current trip level (%)	Iq (%)	Lq @ Iq (mH)	Id (%)	Lq @ Id (mH)	Torque Angle (°)	LSHRM 160 MR1	11	44-00172	Y	50	0.005	0.05	800	21.0	1500	400	0.31582	72.1	236	73	44.845	-108	68.540	56	11	44-00172	Y	60	0.005	0.05	800	20.3	1800	400	0.31582	72.1	244	73	44.845	-108	68.540	56	12.7	44-00172	Y	60	0.005	0.05	800	21.2	1800	460	0.31582	72.1	233	73	44.845	-108	68.540	56	19.1	64-00420	D	87	0.005	0.05	800	38.2	2600	400	0.10527	41.6	218	73	14.948	-108	22.850	56
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NOTE: When setting Pr 05.069 , it may be necessary to increase the value entered, to ensure that the actual trip level displayed in Pr 05.068 is close to (but not greater than) the required value.																																																																																																																																										
Set maximum speed	Set the maximum speed in Pr 01.006 (rpm).																																																																																																																																									
Set acceleration and deceleration rates	Régler : • Acceleration rate in Pr 02.011 (s up to Pr 01.006) • Deceleration rate in Pr 02.021 (s up to Pr 01.006) • Ramp Rate Units Pr 02.039 = On (1) A ramp value of 20s suites most applications. If a braking resistor is installed, set Pr 02.004 = Fast (0). Also ensure Pr 10.030, Pr 10.031 and Pr 10.061 are set correctly, otherwise premature «Brake R Too Hot» trips may be seen.																																																																																																																																									
Additional settings	Set : • RFC Feedback Mode (Pr 03.024) = Feedback (0) • P1 Thermistor Fault Detection (Pr 03.123) = None (0) • Motoring Current Limit (Pr 04.005) = 120% max • Regenerating Current Limit (Pr 04.006) = 120% max • Symmetrical Current Limit (Pr 04.007) = 120% max • Current Reference Filter 1 Time Constant (Pr 04.012) = 1 ms • Thermal Protection Mode (Pr 04.016) = Disabled (4) • User Current Maximum Scaling (Pr 04.024) = 120% max • Maximum Switching Frequency (Pr 05.018) = 3kHz (1) • Enable High Speed Mode (Pr 05.022) = Enable (2) • Minimum Switching Frequency (Pr 05.038) = 3kHz (1) • Voltage Headroom Pr 05.041 = 5%. [Do not set a lower value. Increase this value to 10%, if the motor is unstable in the field weakening area] • Saliency Torque Control Select Pr 05.065 = Auto (3) [Ensure that Pr 05.066 = High (2) otherwise check the value entered for Pr 05.087 from the table] • Inverted Saturation Characteristic (Pr 05.070) = On (1) • Stop Mode (Pr 06.001) = Ramp (1) • Hold Zero Speed (Pr 06.008) = Disabled (0)																																																																																																																																									

Action	Description
Autotune	With the Dyneo⁺ motor, it is necessary to perform a stationary autotune. The motor must be at a standstill before an autotune is performed. A stationary autotune is performed to locate the flux axis of the motor to allow the correct alignment of currents. The stationary autotune measures stator resistance, flux axis inductance, no-load torque axis inductance and values relating to deadtime compensation. Measured values are used to calculate the current loop gains, and at the end of the test the values in Pr 04.013 and Pr 04.014 are updated. To perform an autotune: • Set Pr 05.012 = 1 for a stationary autotune. • Close the run signal (terminal 26 or 27 on Unidrive M700/M701 and terminal 7 or 8 on Unidrive M702). • Close the drive enable signal (terminal 31 on Unidrive M700/M701 and terminals 11 and 13 on Unidrive M702). During a the test a symbol will flash in the top right-hand corner of the display, unless the display has returned to status mode, where the upper row of the display will flash «Autotune». • Wait for the parameter value to return to «None», or for the the drive to display «Inhibit» (in status mode). If the drive trips, remove the enable and run signals, address the cause of the trip, then repeat the test. • Remove the drive enable and run signal from the drive.
Save parameters	Select «Save Parameters» in Pr mm.000 and press the red reset button or toggle the reset digital input.
Start-up	Drive is ready to start-up.

APPENDIX

1500 rpm RANGE																		
MOTOR Type	kW	DRIVE	Coupling	Hz	PARAMETERS													
		M70x			#03.010	#03.011	#04.015	#05.007	#05.008	#05.009	#05.017	#05.033	#05.069	#05.075	#05.078	#05.082	#05.084	#05.087
					Speed Gain Kp	Speed Gain Ki	Thermal constant (s)	Rated current (A)	Rated speed (rpm)	Rated voltage (V)	Stator Resistance (Ω)	BEMF (V/krpm)	Over-current trip level (%)	Iq (%)	Lq @ Iq (mH)	Id (%)	Ld @ Id (mH)	Torque Angle (°)
LSHRM 160 MR1	11	44-00172	Y	50	0.005	0.05	800	21.0	1500	400	0.31582	72.1	236	73	44.845	-108	68.540	56
	11	44-00172	Y	60	0.005	0.05	800	20.3	1800	400	0.31582	72.1	244	73	44.845	-108	68.540	56
	12.7	44-00172	Y	60	0.005	0.05	800	21.2	1800	460	0.31582	72.1	233	73	44.845	-108	68.540	56
	19.1	64-00420	D	87	0.005	0.05	800	38.2	2600	400	0.10527	41.6	218	73	14.948	-108	22.850	56
LSHRM 160 LR1	15	54-00300	Y	50	0.005	0.05	800	27.5	1500	400	0.28454	78.7	199	69	40.485	-110	67.890	58
	15	54-00270	Y	60	0.005	0.05	800	26.8	1800	400	0.28454	78.7	204	69	40.485	-110	67.890	58
	17.3	54-00270	Y	60	0.005	0.05	800	26.7	1800	460	0.28454	78.7	204	69	40.485	-110	67.890	58
	26.0	64-00470	D	87	0.005	0.05	800	48.6	2600	400	0.09485	45.4	189	69	13.495	-110	22.630	58
LSHRM 180 M1	18.5	64-00420	Y	50	0.03	0.1	1000	35.9	1500	400	0.2133	73.1	181	71	31.534	-109	43.300	57
	18.5	64-00420	Y	60	0.03	0.1	1000	35.1	1800	400	0.2133	73.1	185	71	31.534	-109	43.300	57
	21.3	64-00420	Y	60	0.03	0.1	1000	35.5	1800	460	0.2133	73.1	183	71	31.534	-109	43.300	57
	32.1	74-00660	D	87	0.03	0.1	1000	62.9	2600	400	0.0711	42.2	174	71	10.511	-109	14.430	57
LSHRM 180 L1	22	64-00420	Y	50	0.03	0.1	1000	42.2	1500	400	0.13516	71.6	196	73	25.019	-108	33.060	56
	22	64-00420	Y	60	0.03	0.1	1000	40.1	1800	400	0.13516	71.6	207	73	25.019	-108	33.060	56
	25.4	64-00420	Y	60	0.03	0.1	1000	41.1	1800	460	0.13516	71.6	202	73	25.019	-108	33.060	56
	38.1	74-00770	D	87	0.03	0.1	1000	73.5	2600	400	0.04505	41.3	189	73	8.340	-108	11.020	56
LSHRM 200 LQ1	30	64-00470	Y	50	0.03	0.1	1000	57.0	1500	400	0.10831	71.6	174	69	19.675	-110	27.500	58
	30	64-00470	Y	60	0.03	0.1	1000	54.9	1800	400	0.10831	71.6	181	69	19.675	-110	27.500	58
	34.6	64-00470	Y	60	0.03	0.1	1000	56.1	1800	460	0.10831	71.6	177	69	19.675	-110	27.500	58
	52	74-01000	D	87	0.03	0.1	1000	99.3	2600	400	0.03611	41.3	168	69	6.558	-110	9.170	58
LSHRM 225 SZ1	37	74-00660	Y	50	0.03	0.1	1000	70.1	1500	400	0.08873	72.3	164	69	16.697	-110	24.060	58
	37	74-00660	Y	60	0.03	0.1	1000	68.4	1800	400	0.08873	72.3	168	69	16.697	-110	24.060	58
	42.7	74-00660	Y	60	0.03	0.1	1000	69.2	1800	460	0.08873	72.3	166	69	16.697	-110	24.060	58
	64.2	84-01340	D	87	0.03	0.1	1000	122	2600	400	0.02958	41.8	157	69	5.566	-110	8.020	58
LSHRM 225 MG	45	74-00770	Y	50	0.005	0.1	1200	82.1	1500	400	0.04505	76.6	201	67	13.172	-111	23.640	59
	45	74-00770	Y	60	0.005	0.1	1200	79.6	1800	400	0.04505	76.6	207	67	13.172	-111	23.640	59
	54.3	74-00770	Y	60	0.005	0.1	1200	83.1	1800	460	0.04505	76.6	198	67	13.172	-111	23.640	59
	79.2	84-01570	D	87	0.005	0.1	1200	142	2600	400	0.01502	44.2	195	67	4.391	-111	7.880	59
LSHRM 250 ME	55	74-01000	Y	50	0.005	0.1	1200	99.4	1500	400	0.03388	76.6	199	67	10.923	-111	19.660	59
	55	74-01000	Y	60	0.005	0.1	1200	94.7	1800	400	0.03388	76.6	208	67	10.923	-111	19.660	59
	64	74-01000	Y	60	0.005	0.1	1200	97.8	1800	460	0.03388	76.6	202	67	10.923	-111	19.660	59
	95	94-02000	D	87	0.005	0.1	1200	176	2600	400	0.01129	44.2	189	67	3.641	-111	6.550	59
LSHRM 280 SD	75	84-01340	Y	50	0.005	0.1	1200	134	1500	400	0.02461	81.7	185	63	8.988	-114	16.740	61
	75	84-01340	Y	60	0.005	0.1	1200	130	1800	400	0.02461	81.7	190	63	8.988	-114	16.740	61
	86.4	84-01340	Y	60	0.005	0.1	1200	131	1800	460	0.02461	81.7	189	63	8.988	-114	16.740	61
	131	94-02240	D	87	0.005	0.1	1200	231	2600	400	0.00821	47.2	180	63	2.996	-114	5.580	61
LSHRM 280 MD	90	84-01570	Y	50	0.005	0.1	1200	163	1500	400	0.01982	80.4	174	63	7.519	-114	14.400	61
	90	84-01570	Y	60	0.005	0.1	1200	158	1800	400	0.01982	80.4	179	63	7.519	-114	14.400	61
	104	84-01570	Y	60	0.005	0.1	1200	155	1800	460	0.01982	80.4	182	63	7.519	-114	14.400	61
	156	104-02700	D	87	0.005	0.1	1200	279	2600	400	0.00661	46.4	171	63	2.506	-114	4.800	61
LSHRM 315 SN1	110	94-02000	Y	50	0.005	0.1	1200	199	1500	400	0.01534	76.6	165	61	6.646	-115	11.750	62
	110	94-02000	Y	60	0.005	0.1	1200	195	1800	400	0.01534	76.6	168	61	6.646	-115	11.750	62
	132	94-02240	Y	60	0.005	0.1	1200	202	1800	460	0.01534	76.6	163	61	6.646	-115	11.750	62
	192	114-04170	D	87	0.005	0.1	1200	342	2600	400	0.00511	44.2	161	61	2.215	-115	3.920	62
LSHRM 315 MP	132	94-02240	Y	50	0.005	0.1	1400	235	1500	400	0.00952	86	194	59	5.620	-116	9.590	63
	132	94-02240	Y	60	0.005	0.1	1400	234	1800	400	0.00952	86	195	59	5.620	-116	9.590	63
	152	94-02240	Y	60	0.005	0.1	1400	233	1800	460	0.00952	86	196	59	5.620	-116	9.590	63
	229	114-04170	D	87	0.005	0.1	1400	415	2600	400	0.00317	49.6	186	59	1.873	-116	3.200	63
LSHRM 315 MP	160	104-03770	Y	50	0.005	0.1	1400	304	1500	400	0.00604	75.2	192	59	3.800	-116	6.520	63
	160	104-02700	Y	60	0.005	0.1	1400	280	1800	400	0.00604	75.2	209	59	3.800	-116	6.520	63
	184	104-03770	Y	60	0.005	0.1	1400	294	1800	460	0.00604	75.2	198	59	3.800	-116	6.520	63
	200	114-04170	D	50	0.005	0.1	1400	377	1500	400	0.00454	75.8	188	59	3.096	-116	5.410	63
LSHRM 315 MR	200	114-04170	D	60	0.005	0.1	1400	319	1800	400	0.00454	75.8	203	59	3.096	-116	5.410	63
	230	114-04170	D	60	0.005	0.1	1400	366	1800	460	0.00454	75.8	193	59	3.096	-116	5.410	63
FLSHRM 280 SB	75	84-01340	Y	50	0.005	0.1	1400	134	1500	400	0.02461	81.7	185	63	8.988	-114	16.740	61
	75	84-01340	Y	60	0.005	0.1	1400	130	1800	400	0.02461	81.7	190	63	8.988	-114	16.740	61
	86.4	84-01340	Y	60	0.005	0.1	1400	131	1800	460	0.02461	81.7	189	63	8.988	-114	16.740	61
	131	94-02240	D	87	0.005	0.1	1400	231	2600	400	0.00821	47.2	180	63	2.996	-114	5.580	61
FLSHRM 280 MD	90	84-01570	Y	50	0.005	0.1	1500	163	1500	400	0.01982	80.4	174	63	7.519	-114	14.400	61
	90	84-01570	Y	60	0.005	0.1	1500	158	1800	400	0.01982	80.4	179	63	7.519	-114	14.400	61
	104	84-01570	Y	60	0.005	0.1	1500	155	1800	460	0.01982	80.4	182	63	7.519	-114	14.400	61
	156	104-02700	D	87	0.005	0.1	1500	279	2600	400	0.00661	46.4	171	63	2.506	-114	4.800	61
FLSHRM 315 STB	110	94-02000	Y	50	0.005	0.1	1500	199	1500	400	0.01534	76.6	165	61	6.646	-115	11.750	62
	110	94-02000	Y	60	0.005	0.1	1500	195	1800	400	0.01534	76.6	168	61	6.646	-115	11.750	62
	131	94-02240	Y	60	0.005	0.1	1500	202	1800	460	0.01534	76.6	163	61	6.646	-115	11.750	62
	192	114-04170	D	87	0.005	0.1	1500	342	2600	400	0.00511	44.2	161	61	2.215	-115	3.920	62
FLSHRM 315 M																		

APPENDIX

3000 rpm RANGE																			
MOTOR Type	kW	DRIVE		Coupling	Hz	PARAMETERS													
		M70x				#03.010	#03.011	#04.015	#05.007	#05.008	#05.009	#05.017	#05.033	#05.069	#05.075	#05.078	#05.082		
						Speed Gain Kp	Speed Gain Ki	Thermal constant (s)	Rated current (A)	Rated speed (rpm)	Rated voltage (V)	Stator Resistance (Ω)	BEMF (V/krpm)	Over-current trip level (%)	Iq (%)	Lq @ Iq (mH)	Id (%)		
LSHRM 160 MR1	11	44-00172	Y	100	100	0.005	0.05	800	20.3	3000	400	0.25015	43.3	238	73	27.751	-108		
	11	44-00172	Y	120	120	0.005	0.05	800	19.8	3600	400	0.25015	43.3	244	73	27.751	-108		
	12.7	44-00172	Y	120	120	0.005	0.05	800	19.9	3600	460	0.25015	43.3	243	73	27.751	-108		
	19.1	64-00420	D	173	173	0.005	0.05	800	35.8	5200	400	0.08338	25	223	73	9.25	-108		
LSHRM 160 MR1	15	54-00300	Y	100	100	0.005	0.05	800	27.7	3000	400	0.12877	39.3	254	75	17.72	-106		
	15	54-00270	Y	120	120	0.005	0.05	800	27.1	3600	400	0.12877	39.3	259	75	17.72	-106		
	17.3	64-00350	Y	120	120	0.005	0.05	800	28.2	3600	460	0.12877	39.3	249	75	17.72	-106		
	26.0	64-00470	D	173	173	0.005	0.05	800	50.9	5200	400	0.04292	22.7	226	75	5.907	-106		
LSHRM 160 LR1	18.5	64-00350	Y	100	100	0.005	0.05	800	33.7	3000	400	0.12877	39.3	209	71	17.009	-109		
	18.5	64-00350	Y	120	120	0.005	0.05	800	32.9	3600	400	0.12877	39.3	214	71	17.009	-109		
	21.3	64-00350	Y	120	120	0.005	0.05	800	33.1	3600	460	0.12877	39.3	212	71	17.009	-109		
	32.1	74-00660	D	173	173	0.005	0.05	800	61.8	5200	400	0.0429	22.7	186	71	5.70	-109		
LSHRM 180 M1	22	64-00420	Y	100	100	0.03	0.1	800	41.8	3000	400	0.0925	38.2	216	76	12.578	-105		
	22	64-00420	Y	120	120	0.03	0.1	800	40.2	3600	400	0.0925	38.2	224	76	12.578	-105		
	25.5	64-00420	Y	120	120	0.03	0.1	800	41.4	3600	460	0.0925	38.2	218	76	12.578	-105		
	38.1	74-00770	D	173	173	0.03	0.1	800	73.6	5200	400	0.0308	22	200	76	4.20	-105		
LSHRM 200 LQ1	30	64-00470	Y	100	100	0.03	0.1	800	56.7	3000	400	0.0925	38.2	159	69	11.032	-110		
	30	64-00470	Y	120	120	0.03	0.1	800	57.1	3600	400	0.0925	38.2	158	69	11.032	-110		
	34.7	64-00470	Y	120	120	0.03	0.1	800	56.5	3600	460	0.0925	38.2	160	69	11.032	-110		
	37	74-00660	Y	100	100	0.03	0.1	800	69.9	3000	400	0.05333	36.6	178	71	7.982	-109		
LSHRM 200 LQ1	37	74-00660	Y	120	120	0.03	0.1	800	68.8	3600	400	0.05333	36.6	181	71	7.982	-109		
	42.9	74-00660	Y	120	120	0.03	0.1	800	69	3600	460	0.05333	36.6	181	71	7.982	-109		
	45	74-00770	Y	100	100	0.03	0.1	800	84.1	3000	400	0.03715	37.8	180	71	6.802	-109		
	45	74-00770	Y	120	120	0.03	0.1	800	82	3600	400	0.03715	37.8	184	71	6.802	-109		
LSHRM 225 MY1	52	74-00770	Y	120	120	0.03	0.1	800	83.4	3600	460	0.03715	37.8	181	71	6.802	-109		
	55	74-01000	Y	100	100	0.005	0.1	1100	100	3000	400	0.02106	43.4	226	71	5.657	-109		
	55	74-01000	Y	120	120	0.005	0.1	1100	101	3600	400	0.02106	43.4	225	71	5.657	-109		
	63.7	74-01000	Y	120	120	0.005	0.1	1100	100	3600	460	0.02106	43.4	226	71	5.657	-109		
LSHRM 280 SC	75	84-01340	Y	100	100	0.005	0.1	1100	138	3000	400	0.01637	38.3	185	65	4.063	-113		
	75	84-01340	Y	120	120	0.005	0.1	1100	136	3600	400	0.01637	38.3	187	65	4.063	-113		
	86.3	84-01340	Y	120	120	0.005	0.1	1100	135	3600	460	0.01637	38.3	189	65	4.063	-113		
	90	84-01570	Y	100	100	0.005	0.1	1100	167	3000	400	0.01125	38.3	190	65	3.648	-113		
LSHRM 280 MC	90	84-01570	Y	120	120	0.005	0.1	1100	160	3600	400	0.01125	38.3	198	65	3.648	-113		
	104	94-02000	Y	120	120	0.005	0.1	1100	168	3600	460	0.01125	38.3	189	65	3.648	-113		
	110	94-02000	Y	100	100	0.005	0.1	1100	201	3000	400	0.00836	38.3	189	69	2.56	-110		
	110	94-02000	Y	120	120	0.005	0.1	1100	195	3600	400	0.00836	38.3	195	69	2.56	-110		
LSHRM 315 SN1	127	94-02000	Y	120	120	0.005	0.1	1100	197	3600	460	0.00836	38.3	193	69	2.56	-110		
	132	94-02240	Y	100	100	0.005	0.1	1100	237	3000	400	0.00722	40.2	178	69	2.28	-110		
	132	94-02240	Y	120	120	0.005	0.1	1100	234	3600	400	0.00722	40.2	181	69	2.28	-110		
	152	94-02240	Y	120	120	0.005	0.1	1100	232	3600	460	0.00722	40.2	182	69	2.28	-110		
LSHRM 315 MN1	160	104-02700	Y	100	100	0.005	0.1	1100	289	3000	400	0.00495	40.2	188	65	1.989	-113		
	160	104-02700	Y	120	120	0.005	0.1	1100	273	3600	400	0.00495	40.2	199	65	1.989	-113		
	184	104-02700	Y	120	120	0.005	0.1	1100	283	3600	460	0.00495	40.2	192	65	1.989	-113		
	200	114-04170	Y	100	100	0.005	0.1	1100	366	3000	400	0.00383	38.3	172	63	1.734	-114		
LSHRM 315 MN1	200	114-04170	Y	120	120	0.005	0.1	1100	365	3600	400	0.00383	38.3	173	63	1.734	-114		
	233	114-04170	Y	120	120	0.005	0.1	1100	359	3600	460	0.00383	38.3	175	63	1.734	-114		
FLSHRM 280 SA	75	84-01340	Y	100	100	0.005	0.1	1800	138	3000	400	0.01637	38.3	185	65	4.063	-113		
	75	84-01340	Y	120	120	0.005	0.1	1800	136	3600	400	0.01637	38.3	187	65	4.063	-113		
	86.3	84-01340	Y	120	120	0.005	0.1	1800	135	3600	460	0.01637	38.3	189	65	4.063	-113		
	90	84-01570	Y	100	100	0.005	0.1	1800	167	3000	400	0.01125	38.3	190	65	3.648	-113		
FLSHRM 280 MA	90	84-01570	Y	120	120	0.005	0.1	1800	160	3600	400	0.01125	38.3	198	65	3.648	-113		
	108	94-02000	Y	120	120	0.005	0.1	1800	168	3600	460	0.01125	38.3	189	65	3.648	-113		
	110	94-02000	Y	100	100	0.005	0.1	1800	201	3000	400	0.00836	38.3	189	69	2.56	-110		
	110	94-02000	Y	120	120	0.005	0.1	1800	195	3600	400	0.00836	38.3	195	69	2.56	-110		
FLSHRM 315 STA	127	94-02000	Y	120	120	0.005	0.1	1800	197	3600	460	0.00836	38.3	193	69	2.56	-110		
	132	94-02240	Y	100	100	0.005	0.1	1800	237	3000	400	0.00722	40.2	178	69	2.28	-110		
	132	94-02240	Y	120	120	0.005	0.1	1800	234	3600	400	0.00722	40.2	181	69	2.28	-110		
	152	94-02240	Y	120	120	0.005	0.1	1800	232	3600	460	0.00722	40.2	182	69	2.28	-110		
FLSHRM 315 MT	160	104-02700	Y	100	100	0.005	0.1	1800	289	3000	400	0.00495	40.2	188	65	2.21	-113		
	160	104-02700	Y	120	120	0.005	0.1	1800	273	3600	400	0.00495	40.2	199	65	2.21	-113		
	184	104-02700	Y	120	120	0.005	0.1	1800	283	3600	460	0.00495	40.2	192	65	2.21	-113		
	200	114-04170	Y	100	100	0.005	0.1	1800	366	3000	400	0.00383	38.3	172	63	1.734	-114		
FLSHRM 315 LTA	200	114-04170	Y	120	120	0.005	0.1	1800	365	3600	400	0.00383	38.3	173	63	1.734	-114		
	233	114-04170	Y	120	120	0.005	0.1	1800	359	3600	460	0.00383	38.3	175	63	1.734	-114		



LEROY-SOMERTM



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